Labor and Housing Market Responses to Immigration: Evidence from Germany

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1 Introduction

The issue of immigration is of great political, social, and economic importance, because migrants have a major impact on the economy of the destination country in several ways. The number of international migrants worldwide has been growing steadily over the years. Germany ranks among the largest migrant host countries. In 2014, about 13 % of the workers in Germany were foreigners. The increase over the recent decades has been especially significant, as immigrants comprised only 9 % of the German workforce in 1985. What makes immigration interesting to urban and labor market economists is its remarkable concentration in specific regions and cities. According to data from 2014, 85 % of all foreign nationals lived in German urban areas. Therefore, immigration affects the racial-ethnic composition of the domestic population and labor force. The first thought that crosses one's mind concerns the consequences of this phenomenon. Theory alone cannot give a satisfactory answer to this question. Careful empirical research is necessary because an influx of migrants triggers a range of responses from local economic agents.

This thesis offers empirical and methodological contributions to the literature that has tried to estimate the effects of immigration on the German economy. In it, I have examined the impact of immigration on two important markets — the labor market (Chapters 2 and 3) and the rental housing market (Chapter 4).

Chapter 2 focuses on the use of comprehensive German administrative data on the wage and employment effects of immigration. While investigating the impact of immigration on the native labor market outcomes, researchers either decompose the national labor market into skill groups defined in terms of education and experience ("national skill cell approach"), or they use regional variation in the population share of immigrants ("spatial approach") to address the problem of non-random location choices of foreigners by using instrumental variables or natural experiments. The fundamental question in this literature, then, is whether immigrants are complements to natives or perfect substitutes within pre-defined skill categories. I will start with the spatial approach, first, because it has been rarely applied to Germany, and second, so that the results are comparable with those previously identified. Employing an instrumental variable strategy based on the shift-share methodology, I find no support for the hypothesis of adverse labor market effects of immigration. Instead, consistent with previous literature, I find a larger positive effect of highly skilled immigrants on employment probabilities and the wages of natives. This positive effect is partly driven by immigrants from the European Union (EU) countries. However, I propose, as an alternative measure of effective skills, the "occupational approach" (a mixture of both skill cell and spatial approaches) by stratifying the labor markets into occupation groups. This idea is based on the evidence that immigrants and natives do not necessarily compete in the labor market despite having a

similar qualification (D'Amuri et al., 2010; Ottaviano and Peri, 2012; Ortega and Verdugo, 2014). Compared with the spatial approach, my results, by using the same dataset but applying the occupational approach, yield ambiguous effects of the share of foreign workers on the daily wages of natives in occupations between 1990 and 2014. There are both "winners" and "losers" from immigration. Particularly, some occupation groups experience a negative wage effect, when immigration from the non-EU countries increases. A possible explanation is that this approach captures more precisely the labor market segmentation of immigrants and its resulting effect on native wages. It can be concluded that the spatial approach may understate the impact of immigration on the natives' labor market outcomes. Furthermore, by using the skill cell approach, the crucial assumption that workers with a similar educational level are perfect substitutes can be violated.

Chapter 3 refers to the task specialization approach proposed by Peri and Sparber (2009). The authors identified that low-skilled immigrants to the United States are particularly employed in occupations with a clear and specific pattern. They are overrepresented in manual or physically intensive jobs. In contrast, they rarely perform communication-intensive, bureaucratic types of jobs. This is possibly because they have a comparative advantage in occupations that need manual labor and a disadvantage in jobs that demand communication or language skills. The concentration of immigrants in occupational groups produces interesting economic consequences, which we need to consider while analyzing the impact on the native economy. An important conclusion is that immigration encourages workers to specialize. Less educated natives respond to immigration by leaving physically demanding occupations for language-intensive ones to avoid decreasing wages due to the increasing competition with immigrants. This finding motivates the research in this chapter because an extensive analysis about the relationship between immigration and labor-market specialization is missing for Germany. Following the work by Peri and Sparber (2009), with important refinements, I used German data that provides information about the importance of different abilities and skills used in occupations. By using a different measure, I classified the abilities into five broad task types: analytical, communicative/interactive, cognitive, routine manual, and non-routine manual. In a next step, I clustered these into two categories, namely, simple (routine manual and non-routine manual) and complex (analytical, communicative/interactive, and cognitive). The assumption is that the first group is characterized by a higher manual content whereas the second group encompasses tasks that require skills, such as being able to easily converse with other people, make decisions, and solve problems or analyze data. I empirically tested whether the type of tasks performed by the natives within each cell depends on the ratio of the immigrants to the natives in the cell. My results show that the natives respond to an increase in the share of foreign-born workers by increasing their supply of complex tasks. I will also show that this effect varies across demographic groups, being higher

among women and young workers. The magnitude of my results indicates that there are significant differences regarding the impact of immigration on the relative task supply of natives in the United States and Germany.

Chapter 4 takes a different perspective and looks at the effects of cultural diversity (the presence of different nationalities) on the housing market. The main emphasis of the analysis is on the effects of cultural diversity because it is an important determinant of house and rental prices. Yet, the relationship between the share of foreigners as a whole group and the housing market is also taken into account. Another reason for focusing on the housing market is that it is interrelated with the labor market in various ways. First, the spatial equilibrium requires the spatial disparities in the housing prices to be compensated by wage differentials across space (Roback, 1982). On the one hand, an increase in the stock of immigrants stimulates the demand for housing. Combined with an inelastic housing supply, this leads to an increase in housing prices and rents. On the other hand, immigration may be associated with native out-migration (e.g. if natives have a preference for living with natives), decreasing wages, or even socioeconomic segregation. If there is a perfect offset by the native outflow, the local population would remain constant. This means because of the impact of immigrants on housing prices, spatial disparities in immigrant density are expected to induce wage and productivity differentials across cities. Conversely, spatial disparities of wages across the local labor markets, caused by a culturally diverse stock of foreigners (be it through productivity effects or supply shifts), contribute to housing price differentials across cities. In sum, immigration affects both average wages and housing prices across cities through its localized effect on both the productivity of firms and the utility of consumers.

Second, the change in the composition of the local population due to immigration can lead to a change in the local income. This, in turn, would affect housing demand, housing prices, and rents via an income effect. Conversely, changes in housing/rental prices — the largest asset held by households — clearly have an impact on real wages and wealth. Moreover, little is known about the effect of cultural diversity on local housing prices and its social implications for local residents. Third, immigrants are typically workers, as well as residents. Additionally, though the settlement choice of foreigners is related to labor market conditions, they also contribute to a rise in the variety of local goods (e.g. ethnic products, shops, and restaurants), thus, inducing a positive effect of immigration on consumption amenities (Bakens et al., 2013.) Arguably, people of different cultures raise the attractiveness of living in cities, and this "love-for-variety effect" is expected to have a positive impact on housing prices (Ottaviano and Peri, 2006), thereby opposing a potential native out-migration. Finally, the simultaneous consideration of the impact of immigration on both the labor and the housing market may help us better understand the mechanism behind these associations. This chapter documents a positive impact of

cultural diversity on the rental prices of German districts between 2004 and 2013. On the one hand, an increase in the Herfindahl index, as a measure of cultural diversity of 0.1, would increase rents by over 12 % after controlling for relevant explanatory variables, and city and time fixed effects. On the other hand, an increase in the share of foreign-born individuals is associated with a decrease in rents. These results suggest an economic impact that is bigger than that found in the labor markets. Consequently, cultural diversity can be considered to be a city-specific consumption amenity. The positive impact of cultural diversity on the local housing market mirrors the fact that the inhabitants are willing to pay higher rents in cities with a high level of diversity. Natives prefer to live in culturally diverse areas, but they avoid living in areas where the share of foreigners is too high. These findings show that amenity considerations play a role in making decisions on residential location.

2 Employment and wage effects of immigration

2.1 Introduction

In the last decades, several influential articles have been written about the impacts of immigration on native labor market outcomes.[1] Although some of the literature provides inconsistent results, the overwhelming majority of the empirical research has found little or positive effects of immigration on the labor market outcomes of native workers. Recent studies point out imperfect substitutability between natives and immigrant workers within a skill cell (Card, 2009; Ottaviano and Peri, 2012; Kerr et al., 2015). Immigrants and native workers do not compete for the same type of jobs because they are not perfectly substitutable. Hence, immigrants may take jobs natives no longer consider to be attractive.

According to the literature, the economic channel of how local labor markets respond to immigration can be shown in a very simple labor demand and supply model. The main assumption is that all the workers are homogeneous. Such a "basic canonical model" with a negatively sloped labor demand curve implies that in the short run, an increase in labor supply due to immigration, keeping everything else constant, produces a decline in wage and/or in employment for the competing native workers. There are credible reasons to believe that this strongly-simplified model neglects some crucial aspects. For example, immigrants are not homogeneous to natives, because they bring different skill sets and abilities. Indeed, standard economic theory suggests a positive effect on wages if native and immigrant workers have complementary skills in the labor market (Docquier et al., 2014; Foged and Peri, 2016).

There are some reasons for focusing on the German labor market to empirically investigate the relation between immigration and the labor market outcomes of natives. First, labor market institutions in Germany are relatively rigid. Furthermore, unemployed persons benefit from the advantages provided by the welfare state which increases the potential for negative consequences due to immigration in the short run. Newcomers are more likely to stay jobless and impose a cost on society. In such a context, the impact of immigration might be different on the German labor market compared to the more flexible US market. Second, the variations in the immigrant share across skills or ethnic groups observed in Germany over time are not similar to the ones experienced in other countries. Finally, the effects of immigration depend on the composition of native and immigrant workers, in terms of educational attainment and work experience, and not just on the overall inflow of immigrants (D'Amuri et al., 2010).

[1] See, for example, Grossman, 1982; Friedberg and Hunt, 1995; Card, 2001; Borjas, 2003; Peri, 2012.

The purpose of this chapter is to study how the wages and employment of different groups of natives are affected by an increase in the number of competing immigrants. Unlike in most studies, two contrasting approaches were used. The most common method has been the spatial correlation approach (the macro level), which focuses on the geographic distribution of immigrants to analyze the association between the proportion of workers with a foreign background and the labor market outcomes of natives. But according to observations, immigrants and natives work in different occupational segments despite having similar qualifications (Steinhardt, 2011). The implication is that the identification strategy based on formal education characteristics might lead to biased estimates if the German labor market is characterized by an occupational segregation of immigrants. As an alternative, I propose the occupational approach (the micro level), which considers occupations on the more disaggregated level as the unit of investigation. To assess the impact of immigration in more detail, I classified immigrants into two groups — those from the EU member states and those from outside the EU (non-EU). The rationale behind this strategy is that migrants from the EU and non-EU countries may possess different skills or characteristics, which can have a different impact on the labor market outcomes of natives. This issue has been neglected in the literature so far. The current study attempts to fill this gap and presents new evidence.

A novel contribution of this study is that I took advantage of the individual dimension of the panel data on German workers from 1990 to 2014 to quantify the impact of a change in the supply of foreign workers on the labor market outcomes of native employees. I exploited a representative sample with a large number of observations to make the results immune to attenuation biases. The administrative data I used allowed me to control for unobserved individual characteristics and heterogeneous effects. To put it differently, I applied different estimation techniques to examine the labor market effects of immigration. Another notable contribution of this study is that I used different specifications. For instance, in contrast to earlier approaches in the literature, I did not treat male and female natives as a homogeneous group. In particular, the number of women participating in the labor force has grown over the last decades. Alongside this development, another striking trend can be observed: the level of qualification of women has increased considerably, and it is now approaching that of men. So, we can expect different effects of immigration on gender.

My main results are the following: Overall, I find a positive significant effect of immigration on the structure of earnings or on the employment rates in German regional labor markets, applying the spatial approach. An immigrant-induced increase in the number of workers by one percentage point in a particular skill group raises the wages of natives by 0.2 to 3.5 %. This finding is consistent with several prior studies which used data for

other countries (Winter-Ebmer and Zweimüller, 1996; Ortega and Verdugo, 2014; Foged and Peri, 2016). Moreover, natives in the districts with a higher concentration of more educated foreign-born workers experienced significantly faster wage growth. In contrast to the spatial approach, my results using the same dataset but employing the occupational approach yield ambiguous effects of immigration on the wages of native workers. While most of the native occupational groups gained from immigration with wage increases between 0.48 and 4.6 %, a few lost. The negative effect was driven by immigrants from non-EU countries. The occupational groups most negatively affected were the agriculturists and technicians. These two groups suffered wage decreases of 1.3 and 4.8 percent respectively. The results are robust enough for the implementation of an instrumental variable (IV) strategy. To account for the bias that may arise from the non-random settlement decisions of immigrants across areas, I constructed a suitable instrumental variable for the endogenous regressor: the share of foreign-born workers. I used historical data to predict the locational distribution of immigrants for the subsequent inflows. This strategy is based on the idea that the stock of previous immigrants has an impact on subsequent flows through network effects, while assuming that past immigrant concentrations are uncorrelated with the current unobserved economic shocks.

The rest of the chapter is organized as follows. Section 2.2 presents the commonly used methods and findings of the relevant literature. Section 2.3 outlines the theoretical model. Section 2.4 describes the data used.[2] Next, Section 2.5 provides some descriptive statistics. Section 2.6 discusses the empirical specification, the identification strategy, and the construction of the main variables. Section 2.7 reports the results of the empirical analysis. Finally, in Section 2.8, I provide some robustness checks to assess whether the effects of immigration on natives' labor market outcomes vary across demographic groups. Section 2.9 concludes the thesis.

2.2 The state of knowledge: Methods and findings

A key question on migration concerns its benefits and costs for the receiving economies. Longhi et al. (2005) noted in their meta-analytical assessment of the empirical literature more than 350 estimates of the elasticity of the native wage with respect to the relative supply of immigrant labor. Many researchers have evaluated wages or employment as the variable because the public and policymakers are primarily interested in these. The estimated impact of immigration on the labor market outcomes of native workers fluctuates widely between the studies (and sometimes even within the same study), but seems to cluster around zero. This section explains why the results of empirical evidence deviate

[2]A detailed description is provided separately in Table 2.8 in the Appendix.

from the elementary textbook model. First, I discuss the methods used, as well as the results generated from their application.

The studies have mostly used three popular statistical modeling approaches to estimate the labor market effects of immigration: *the spatial correlation method, the skill cell approach, and a quasi-experimental approach, which is also called the "unexpected exogenous supply shock" (UESS) approach.* The first method exploits geographical variation in immigrant concentrations and yields estimates from the relationship between labor market outcomes and those concentrations. The following example illustrates how this approach works. Consider an economy that can be divided into two regional labor markets, R1 and R2. The assumption is that both regions are identical to each other. Now suppose immigration happens, and due to personal preferences, all immigrants are settled to labor market R1. The effect of immigration on wages and employment can now be measured by comparing the wages (and employment) between labor markets R1 and R2, and relate it to the relative magnitude of immigration. In this example, R2 serves as the counterfactual: it represents R1 in the absence of immigration. Following this hypothetical experiment, and transferring it to a country, an empirical implementation would then regress a measure of employment or the wages of resident workers in a given area on the relative quantities of immigrants in that particular locality and the appropriate covariates expected to influence the dependent variable (Dustmann et al., 2007). If native-born and immigrant workers are substitutes in the sense that they compete for the same jobs, this model predicts a negative correlation between immigration and the wages of native workers. All other factors remaining equal, the higher the immigrant density in the local labor market, the lower is the wage. But, immigrants increase the wage of native workers if these two groups have skills that complement each other (Bodvarsson and Van den Berg, 2013).

To implement this approach, however, the analyst has to make some assumptions. Most importantly, it is assumed that the sorting of foreigners into certain labor markets of the destination country is random and independent of permanent labor market conditions in the respective region. However, pre-migration conditions in the local labor markets are usually not identical (e.g. Munich is economically more successful than the city of Chemnitz in Saxony), and the allocation of immigrants is endogenous to local labor market conditions. Typically, migrants will choose the local labor market that provides the best economic prospects, like more job opportunities. The concern is that this endogeneity creates a bias in the estimate of the coefficient for the share of foreign workers. Many researcher use the IV technique to deal with this problem, to remove the effects that can influence immigrants' location choices. This aspect is discussed in more detail in the section Estimation approach.

Another drawback of the spatial correlation approach is that it neglects the endogenous movement of workers between regions and particular labor market segments. For example, the adverse effect on native wages triggered by immigration will motivate natives to move elsewhere to mitigate their wage losses or pursue other careers in terms of job reallocations (Bodvarsson and Van den Berg, 2013). This will tend to disperse the wage impact of immigration through the national economy, and undermine the ability to identify the true wage impact within areas. In the worst case, the effect of immigration on wages or employment can be perfectly balanced by an adequate native outflow in response to immigration.

The most consistent way to address this problem is to measure the outflows of residents, and incorporate them directly into the estimation. However, such outflows are likely to be correlated with shocks to local economic conditions for the same reasons as immigrant flows, creating a further simultaneity issue. These outflows, therefore, also need instrumenting, and it is theoretically less clear what would serve as a suitable instrument even if lags are an option. The problem can, in principle, be ignored if the generated pressures for the outflow of natives are not strongly enough. Eventually, this issue can be taken seriously by using small spatial units, like in this context. For example, the application of aggregated spatial units, like that at the federal states level, may capture the potential native migration responses better. It is conceivable that natives will move from Duisburg to Düsseldorf in response to immigration, whereas it is unlikely that they will move to Berlin. In my dataset, the proportion of natives who have changed their workplace, in the sense of leaving the local labor market (district), is around 3 %. This means that the natives' regional mobility is quite low. My analyses also took into account the areas where workers are employed, and the proportion of migrants in those areas. Card (2001), for example, found that the inflow of migrants does not generate an outflow of native citizens for US data. However, Borjas et al. (1997) considered the out-migration of natives as a result of wage-depressing effects of immigrants as a far more important factor, leading to a bias towards zero while estimating the effects using the spatial correlation approach. Relating thereto, Borjas et al. (1996) remarked, "If native migration responses are sufficiently large over the relevant period, comparisons of small areas will mask the true effects of immigrants on native wages." It is difficult to conclude the extent to which this potential bias affected the results of the studies reviewed below, which largely suggest no negative effect of immigration on local natives' labor market outcomes. This shortcoming of the spatial correlation method served as the inspiration for the next empirical strategies, which I will discuss now.

The skill cell approach, which uses the stock of migrants for a given education-experience group, has been proposed by Borjas (2003). The idea is to partition the national labor

market into measured skill and experience categories to estimate the impact of exogenous immigration to those categories. The first step in applying this approach is to construct the skill and experience cells. The aim is to exploit the distribution of immigrants across skill and experience cells to identify their impact on wages. The crucial factor here is to aggregate individual data to skill and experience cells so that individuals in a given cell are perfect substitutes for one another, and individuals in difference cells are imperfect substitutes. Borjas used the age cohort as the proxy for experience. The underlying assumption is that workers — whether native or immigrant — with the same level of education and experience are perfect substitutes. But workers with the same level of education but different experience — and the same experience but different education — are imperfect substitutes. For this analysis, Borjas created four educational groups (high school dropouts,[3] high school graduates,[4] persons who have some college,[5] college graduates [6]) and eight labor market experience groups (five-year bands for workers with one to 40 years of experience), for 32 education-experience cells. To determine the effect the immigrant share has on the labor market outcome (wages) of natives, the following specification is estimated:

$$y_{ijt} = \beta S_{ijt} + s_i + \chi_j + \pi_t + (s_i \times \chi_j) + (s_i \times \pi_t) + (\chi_j \times \pi_t) + \varepsilon_{ijt} \ , \tag{2.1}$$

in which y_{ijt} represents the mean wages for native workers in a cell (i, j, t); s_i is a vector of fixed effects which indicates educational attainment that controls for the time-invariant unobserved heterogeneity between the skill groups; χ_j is a vector of fixed effects, indicating work experience; π_t is a vector of time fixed effects for time-varying shocks; and ε_{ijt} is a normally distributed residual term. For each of these cells, the share of immigrants in the total number of workers in an education-experience group is measured as:

$$S_{ijt} = M_{ijt}/(M_{ijt} + N_{ijt}) \tag{2.2}$$

in which M_{ijt} represents the number of immigrants in a cell (i, j, t), and N_{ijt} represents the corresponding number of natives.

A key feature of this model is that it absorbs all the possible cross-skill complementarities and aggregate externalities that immigrant workers generate. Namely, regressions estimate the effect of immigrants on the same skill-experience group, considering those in other skill-experience groups as the constant. Studies applying the spatial correlation method suggest a negligible influence of immigration on native-born wages or employ-

[3] They have less than 12 years of completed schooling.
[4] They have exactly 12 years of schooling.
[5] They have between 13 and 15 years of schooling.
[6] They have at least 16 years of schooling.

ment, while the skill cell approach exhibits more substantial impact, at least in the short run.

An important prerequisite of the skill cell correlation approach is that immigrants can be allocated to skill groups based on their observable characteristics (education and experience). In particular, it excludes the possibility for immigrants to select the skill cells in which the economic conditions are better, or for them to be forced into particular cells, which are "downgraded" (mismatched) in the host economy's labor market, for some reason. This, however, may be very difficult, as immigrants experience a skill downgrading just after arrival, and improve their economic position in the years after arrival. That may make pre-allocation difficult. In other words, the assumption of perfect substitutability between immigrants and natives within skill groups may be clearly violated if immigrants tend to be downgraded in the host country and compete with natives of different skill groups (Amuedo-Dorantes and De la Rica, 2011). Muysken et al. (2015) provided evidence that the issue of immigrants' skill downgrading is substantial in Germany. Another important factor is that work experience in the country of origin may have a different labor market value than experience in the destination country. The more robust UESS approach does not have these concerns.

The idea behind the UESS approach is similar to the spatial correlation method. The crucial difference is the focus on one exceptional time in terms of immigration inflows. For example, a rare (commuting) policy by the state or government in a particular year can generate "forced" movements across borders. In this way, immigrants cannot self-select themselves into a certain country; instead, they will be forced to move from one area to another based on reasons orthogonal to their country preferences. In the baseline setting, it is supposed that there is a "treatment group", for instance, a region that is confronted with migration versus a "control group" (another region) that is spared of immigration. Moreover, the "pre-immigration" versus "post-immigration" period have to be defined. An important criterion for the examination of shocks, which are driven by exogenous forces, is the similarity between the treatment and control groups with respect to particular factors, like the geographical location, cultural background, social norms, and attitudes, and the level of economic development, while they are different in the form of exogenous immigrant concentration. In such a case, the choice of the counterfactual is extremely simple. The UESS is an ideal research design to tackle the endogeneity problem of immigration, which arises, for instance, because immigrants might select labor market segments with good economic prospects or high labor demand. The UESS studies have two common characteristics: First, an unexpected case of extraordinary migration flows caused by a shock, which is mostly politically motivated. Second, these studies apply the difference-in-difference method to assess the effects of the shock on the labor market outcomes of natives in the destination country. One deficiency of a quasi-natural experiment

is that it is difficult to find equivalent test groups that can limit the generalizability of the results to a larger population. For example, Glitz (2006) estimated the specific issue of the impact of ethnic German immigration after the German reunification on the relative skill-specific employment and wage rates of German residents. The results of this study cannot be transferred to the entire group of migrants. The main weakness of the UESS approach is that the analysis has to be restricted to the period when the exogenous shock occurs. Similar to the aforementioned methods, the UESS studies generally found very little impact of immigrants on the natives' labor market outcomes.

2.2.1 Applications of the Spatial Correlation method

It is important to emphasize that the empirical studies on the impact of immigration on the economies of host countries vary widely in terms of the methodology used and the nature of the data on which the estimates are based. Furthermore, due to data limitations, most of these studies have either considered variations in the extent of immigration and the wages across industries (New and Zimmermann, 1994), or used data aggregated at the regional level (Pischke and Velling, 1997) to estimate the labor market effects of immigrant-induced increases in labor supply.

Butcher and Card (1991) sought to explain changes in wages of low- and highly-paid workers across 24 US cities from 1979 to 1989. The reason for focusing on low-skilled workers is that they are the most likely to be adversely affected by immigration. The authors found no evidence for a negative effect of immigration on the wages of native workers, either across cities or within cities over time. However, they found that the growth in wage inequality was positively correlated with the growth rates in immigration. But higher inequality came in terms of a more rapid increase in the 90th percentile of wages, and not with a relative decline in the 10th percentile.

Goldin (1994) applied a differencing model to city-level data for 1890–1923 to estimate the effect of an increase in the share of immigrants on the changes in native wages in different industries in the US. She found that a percentage point rise in the city's fraction of immigrants reduces native wages between 1 and 1.6 %. However, Friedberg and Hunt (1995) pointed out that Goldin's result may be biased from the use of aggregate data. In Goldin's paper, city-level wages are a composite of immigrant and native wages. This approach resulted in the conclusion that if the immigrants, on an average, earn less for some reason, the cities with higher immigrant concentrations will have lower wages, even if an adverse effect of immigration is absent. The problem could have been avoided by separating between natives' and immigrants' earnings in the data.

Applications of the spatial correlation approach continued through the 1990s. Important studies during this period include the analysis of Borjas et al. (1997). The authors

estimated the relationship between immigration and labor market outcomes of natives for 1960, 1970, 1980, and 1990 across the US. They found that immigration does not have a consistent, discernible effect on the area economic outcome. The coefficient for the share of foreigners changed significantly over the decades. For example, they identified a negative estimator for the 1960s, but a positive one (and larger in absolute value) for the 1970s, followed by a negative coefficient during the 1980s. At the regional level, the regressions suggest that a 10 percentage point increase in the relative number of immigrants reduces the earnings of male natives by 1.3 % in the 1970s, but would have increased the same group's wages by 0.8 % during the 1980s. A possible explanation, according to the reversal sign of the coefficients, may have been the long-term changes in the wage structure which are not fully understood and accounted for in the regressions (Borjas, 1999).

Card (2001), in his seminal study, estimated regression equations derived directly from his theoretical model. Card used cities as the spatial unit, but stratified the sample along occupational lines. Card argued that it is useful to divide the labor market into occupations because natives and immigrants compete within each cell. He, thus, used the fraction of foreigners in occupations, rather than the overall immigrant density in the local market, as most previous studies had done. His dataset was a cross-section drawn from the 1990 US Census, and included labor market outcomes of natives aged between 16 and 68 years with at least one year of experience on the labor market. The analysis was based on the 175 largest US cities. Card's essential finding was that inflows of new immigrants put more pressure on less educated natives than on the other native groups. First, a one percentage point increase in the share of foreigners in occupations would, all other things being equal, lower the employment rate by 0.1–0.2 percentage points. Corrected for selectivity bias, the estimated coefficients on the immigrants' density from the wage regressions appear to induce mildly adverse to zero effects. The estimates predict that a 10 % inflow rate of immigrants reduces native male wages by 1.5 %, and raises native female wages by 0.63 %. There are some small differences across various demographic, occupation-, and city-based groups. All these results are in line with the findings of the earlier studies (Bodvarsson and Van den Berg, 2013). Another research question was the investigation of whether immigrant inflows induce offsetting outflows of natives and former immigrants. Card found that natives and older immigrants do not move outside the city after new immigrants have arrived. This result, therefore, suggests that researchers may not need worry about internal migration when estimating the impact of immigration.

Dustmann et al. (2005) performed a cross-section analysis on British data to test the effects of immigrants on both wages and unemployment rates of native persons. Their theoretical model derived two important implications: (1) wages depend not only on the relative immigrant supply, but also on the composition of skills in the native population; and (2) the skill mix and immigrant labor force should be included separately in the

regression equation. The researchers estimated different regressions by applying OLS, first differences, and IV strategy. These three estimation procedures provided divergent results. While OLS showed a negative and significant relationship between the native unemployment and the regional immigrant share, the IV method generated no significant estimates. Overall, the final results represented no strong evidence of the impact of immigration on native unemployment rates, and very mixed result for wages.

2.2.2 Applications of the Skill Cell approach

Some researchers have used the skill cell method to address the concern regarding the shifts in native worker migration in response to the presence of immigrants in a specific city or region. The underlying idea is that if there is little mobility between skill cells, and there are observations for workers in skill cells across the country, the estimates of immigrants entering that particular skill cell should not be biased by geographic migration. In contrast to much of the evidence provided above, Borjas (2003) found statistically significant adverse effects on native workers' earnings. The elasticity with respect to the key variable was estimated to be -0.40, which implies that a 10 % rise in the number of immigrants reduces the weekly earnings of men aged between 18 and 64 by 4 %. Borjas compared this result with labor cells defined geographically (by state), and found that the adverse impact of immigration had diminished it by about two-third. He pointed out, first of all, this as strong evidence that the effects of migration on a particular area diffuse into other areas through internal migration, capital relocation, and other adjustments. This indicated the importance of analyzing the effect of migration outside the scope of one region or city.

Borjas recognized that his estimates are not without potential sources of bias. His result had two conceivable shortcomings. First, they did not account for an important source of measurement error in the experience variable. Second, they were based on the assumption that each cell comprises an isolated labor market. In other words, important changes in the wage distribution and the educational level were ignored. After making a number of modifications or refinements, Borjas found that immigrant inflows adversely affected the pay of most natives, especially those at the end of the education distribution. While the workers without a high school degree experienced a relative wage decline of 8.9 %, university graduates lost 4.9 %. Workers with a high school degree experienced, with 2.6 %, the smallest drop in relative wages. On an average, the wage elasticity of the native worker with respect to the immigrant was -0.32. These results were in accordance with the fact that educational attainment of immigrants to the US is, relative to the native US population, strongly skewed towards the extremes of very low education or very high levels of education. In sum, Borjas's results may more closely mirror the effects predicted by the traditional labor market model of immigration.

Ottaviano and Peri (2005, 2012) extended the model of Borjas (2003) to include endogenous adjustments of the capital accumulation to immigration shock under the assumption of imperfect substitutability between native and foreign-born workers within a skill cell. They analyzed the same period as Borjas (1990–2000), using the same data sources. The researchers estimated that the elasticity of mean wages to immigration amounts to 0.275. This means that an 8 % increase in the number of foreign workers increased the average wage by 2.2 %. The main conclusion is that immigration appears to benefit all labor groups except for the least educated. While the top three schooling groups gained from immigration, the lowest schooling group suffered a decline of 2.4 %. In their 2012 study, Ottaviano and Peri estimated a value of 5.88 for the within-cell elasticity, again conforming to imperfect substitutability between native and foreign workers. According to their result, university graduates' real wages rose by 0.7 % and high school graduates' wages by 3.5 %. The impact of immigration on the extremes of the occupational distribution was similar, but not identical to the result of Borjas. Ottaviano and Peri ascertained that their results changed substantially when they assumed perfect substitutability between US-born agents and foreigners, rather than partial substitutability.

Ortega and Verdugo (2014) used the factor proportions methodology proposed by Borjas (2003) to investigate the effects of immigration on the French labor market over 30 years, from 1968 to 1999. They found that a 10 percentage point increase in the immigrant share raised natives' wages by 3.3 %, which was in stark contrast to the results of Borjas for the US. This positive impact was shown to hold at the regional level too. The authors argued that the positive correlation is partly driven by imperfect substitutability of natives and immigrants within education or experience cells. Specifically, if there were more immigrants in the cell, the occupational distribution of natives and immigrants within these cells showed a more dissimilar pattern. Another important source of the positive relation between immigration and wages was the reallocation of natives to better-paid occupations within the cells. The differences in the institutional design between these two countries could also be responsible for the obtained results. For example, the minimum wage and a more centralized wage bargaining still play a big role in France.

2.2.3 Applications of the Unexpected Exogenous Supply Shock method

A prominent application of the UESS is the classic study by Card (1990), who made use of a natural experiment by analyzing the impact of the Mariel Boatlift from Cuba on the labor market of Miami. This rare occurrence provided a powerful case study because the author used as the identifying variation the differences in the likelihood that these new immigrants would settle in particular areas of the country. After an extraordinary sequence of events, the Cuban president Castro allowed all Cubans who wished to migrate to the

US to do so from the harbor of Mariel. This incident explains why the mass migration came to be known as the Mariel Boatlift. In a short period (between May and September 1980), around 125,000 undocumented Cubans entered the US. Around half of the Mariel immigrants settled down suddenly and unexpectedly in Miami, increasing the city's labor force by 7 %. The percentage increase in the labor supply to less-skilled occupations and industries was even greater because most of the immigrants were relatively unskilled.

Card used micro-data for 1979–1985 to test the effect of the Mariel influx on the wages and unemployment rates of five different demographic groups — white, black, non-Cuban Hispanic, earlier Cuban immigrants, and all low-skilled workers for the first five years following the influx. Card's counterfactual group included four cities (Atlanta, Houston, Los Angeles, and Tampa-St. Petersburg), because these cities experienced patterns of economic growth similar to Miami during the period. In this context, the investigation provided some valuable and surprising findings: the sudden large inflow of Cuban immigrants appeared to have almost no effect on the wages or the unemployment rates of less-skilled workers. This was a new finding because the traditional labor supply model predicts a different outcome. Card identified that in 1979–1985, not only did the wages of the Cubans who had migrated to Miami earlier fall, those of whites, blacks, and Hispanics in the compared cities fell too. The white unemployment rate decreased from 5.1 to 3.9 % while the compared cities experienced a slight decline from 4.4 to 4.3 %. Black workers' unemployment rate rose from 8.3 to 9.6 %. But the increase from 10.3 to 12.6 % in the counterfactual cities was obviously higher. This result was unusual because on the basis of similar skills, blacks seemed to be the most substitutable group for the Mariel immigrants.

The author justified these results with the argument that the ability of Miami's labor market to rapidly absorb the new workers was largely because of its adjustment to other large waves of immigrants from Central America or the Caribbean in the two decades before the Mariel Boatlift. It was relatively easy for Miami to expand employment opportunities because the city was better prepared to deal with the new immigrants than any other city was. Another advantage of Miami was its industrial structure. It was easier for low-skilled Spanish-speaking immigrants to find a job. However, the importance of the relatively flexible US labor markets should also not be underestimated because the effects throughout the region were dissipated by the out-migration of competing workers. Card suggested that even this offsetting out-migration was the reason for the benign effects of the immigration shock (Bodvarsson and Van den Berg, 2013). The traditional models often ignore another important aspect: the presence of new immigrants triggers a multiplier effect by boosting the demand of goods and services, which, in turn, contributes to the increase of production and to the demand for workforce.

The often-cited study by Friedberg (2001) refers to the nearly one million Russian immigrants who arrived in Israel during the 1990s. When the Soviet Union lifted its restriction on legal emigration, many Russian Jews went to Israel. Friedberg reported that the influx of Jewish Russians increased Israel's population by 12 % between 1990 and 1994. This level of migration were relatively much larger than, for example, the one experienced by the US or Western Europe. Therefore, the natural experiment had several important features. First, there is no doubt that there are exogenous migration flows driven by a change in policy in the source country. Secondly, just as importantly, Israel is a very small country, and almost all geographic areas were affected by the Russian immigration. It should be noted that if an immigration shock penetrates only a part of a country, flexible markets will diffuse the effects of the shock to unaffected areas. The challenge for researchers is the estimation of the true effects of immigration. Third, the new Jewish Russians were well-skilled and had a strong labor market experience. Friedberg pointed out that in the short run, labor market outcomes in the host country may not depend on the immigrant skill distribution because language barriers force many immigrants to compete with less-skilled natives for blue-collar jobs (for example, jobs in manufacturing, mining or construction). But, in the long run, the labor market's reaction to highly educated migrants can be different.

Friedberg's survey data were a random sample of 3,300 new immigrants who came to Israel in 1990. This dataset was collected through interviews, and included information on the immigrants' education or job experience prior to immigration. The author found large differences between the occupation wage effects across various specifications of regression models. She exploited information on the immigrants' former occupations abroad as the instrumental variable. The estimate of her OLS regression for groups of people in each profession showed an estimate of -1.54. This can be interpreted as follows: a 10 % gain in employment due to immigration induced a 15.4 % drop in average wages. The 2SLS first-differenced version yields a statistically insignificant coefficient of -0.62. These results pointed out that due to the simultaneity bias, the OLS regressions overstated the effect of immigration on wages. Thus, it appeared that the Russian immigrant influx did not adversely affect native Israeli wages. In assessing her results, Friedberg suggested that complementarities between the Jewish Russian immigrants and the native Israelis might have played a role. For example, many of the doctors among the new immigrants took low-paying, less desirable positions in Israeli hospitals, which may have encouraged native Israeli doctors to move to more attractive and more lucrative positions. Moreover, there was a rapid growth of the high-tech industry in Israel, which had probably stimulated labor demand across occupations, including those with higher Russian immigrant concentrations.

Another UESS study also found a negligible effect of immigrants on native labor market outcomes. Hunt (1992) used census data to examine the impact of the 900,000 people who repatriated from Algeria in 1962 on the French labor market. The Repatriates of the French-Algerians after the end of the colonial rule in Algeria settled in the regions culturally and climatically similar to the home country, and represented 1.6 % of the total French labor force in 1968. She estimated that a 1 % increase in the immigrants' share of the labor force induced a drop in the regional wage by 0.8 % and raised the unemployment rate of the natives by 0.2 %. The average annual salaries were lower by at most 1.3 % in 1967 due to their arrival. There is no evidence that potential immigrants from abroad and migrants in France were discouraged from moving to areas with many repatriates.

A recent paper by Foged and Peri (2016) used longitudinal data on the universe of workers in Denmark during the 1991–2008 period to analyze the labor market outcomes of low-skilled natives in response to an exogenous inflow of low-skilled immigrants. Their identification strategy focused on the immigrants distributed across municipalities by a dispersal policy that took place between 1986 and 1998. First, the authors found that an increase in the supply of refugee-country immigrants had a positive effect on native unskilled wages, employment, and occupational mobility. Second, for comparison purposes, the intended area-based analysis revealed that the direction and magnitude of the effects on native outcomes were similar in the long run. This finding dispels the claim that the estimates from spatial analysis are uninformative or significantly biased.

2.2.4 Previous empirical evidence for Germany

Even though the number of studies is not comparable with that in the US, a few notable papers have investigated the impact of immigration on the German labor market. Table 2.1 summarizes the selected studies of the effect of immigration on German native wages. A prominent example of the application of the skill group approach of Borjas (2003) is the study by Bonin (2005), who estimated the impact of immigration on the German labor market using data provided by the Institute for Employment Research (IAB) for the period of 1975–1997. Like the original model, the author used only a pooled OLS method and found small wage effects of migration on native workers but no effect on unemployment. An increase in the foreigners' share by 10 % relative to the native workforce within a skill group reduced native wages by 1.02 %. In addition, the regression results showed that domestic workers with low education are disproportionately affected by immigration.

Table 2.1: Summary of the selected studies of the effect of immigration on native wages

Study	Sample	Method	Results
Bonin (2005)	Men, 1975–1997	Skill cell approach	Immigration lowers wages with elasticity = -0.10, more negative for low-skilled workers.
Glitz (2006)	Men and women, 1996–2001	Quasi-experiment	Immigration displaces native employment by skill group but does not affect wages.
D'Amuri et al. (2010)	1992–2001	Skill cell approach	Immigration raises less educated workers' wages by 1.68 %, lowers wages of highly educated workers by 1.01 %.
Bauer et al. (2013)	Men, 2000–2005	Spatial approach	Immigration has no adverse effects on the wages of either low- or high-skilled workers.

Source: Own illustration.

Glitz (2006) also used a linear regression model (OLS method) to estimate the impact of foreign workers on the labor market of Germany. The regression equation included independent variables like wages, population, and employment of natives in the host country. This model was based on 112 German labor market areas and the considered time series data for the period from 1996–2001. The study identified a displacement effect of four unemployed native workers for every 10 immigrants who took a position. This means that out of every 10 immigrants who found a job, four occupied positions intended for native workers, and the remaining six filled new positions. Thus, foreign-born employees displaced native workers in the labor market and increased their unemployment. Another key conclusion of the study was a negative impact of immigration on the host country's wages: a 10 % increase in skill share leads to a 0.49–0.58 % decrease in relative wages.

D'Amuri et al. (2010) in their research estimated the impact of substantial immigration of the 1990s on the German labor market. They extended the original framework proposed by Borjas (adding imperfect native-immigrant substitutability) to adopt the general equilibrium model setting of Ottaviano and Peri (2006). They measured that immigration has no negative or even a slightly positive impact on the wages and employment levels of natives. It had, instead, adverse effects in terms of employment and wages on previous waves of immigrants. This stems from the fact that after controlling the degree of education and experience, native and migrant workers appear to be imperfect substitutes in the production process whereas new and old immigrants exhibit perfect substitutability.

Another study was conducted by Bauer et al. (2013), who analyzed the impact of immigration on 103 local labor markets in Germany, applying panel regression on time

series data from 2000 to 2005. Their empirical analysis employed a dataset that combined two data sources: longitudinal individual data from the German Socio-Economic Panel (SOEP) and process-generated data from the federal employment office provided by the IAB. The authors used the regional share of old buildings at the beginning of the 1960s as an instrument for the regional share of foreigners to avoid potentially biased estimates due to the non-random sorting of immigrants within cities. This instrument seemed to be appropriate for the analysis, since many old buildings were destroyed during and after World War II, especially in the industrial regions which have attracted millions of "guest workers". The rationale behind this strategy is that there is a negative correlation between the regional share of foreigners and the share of old buildings. According to this study, immigration to Germany had no adverse effect on the wages of either low- or highly skilled German workers. However, empirical findings showed a positive effect of immigration on the employment probability of highly skilled natives, suggesting that immigrants constitute complements for highly skilled native-born workers in the German labor market. This study also utilized regional variation in the population share of foreigners to examine the response of native workers' outcomes by using new representative individual panel data spanning several years.

2.3 The theoretical model

When immigrants enter a country, they affect the destination country's economy through different channels. In fact, immigrants are not just workers. They are also entrepreneurs, taxpayers, and consumers of goods or services. This increased demand helps create more employment opportunities. But immigration can also reduce the pay and job chances of the natives due to more competition for jobs. Most of the traditional analyses conclude that some native groups gain from immigration while others lose out. The sum of gains and burdens depends critically on the features of the model, like the hypothesis, whether the workers are homogeneous or not. This section introduces a straightforward model based on Dustmann et al. (2005) to analyze the labor market effect of immigration.

Let us assume that the country's population consists of natives, N and immigrants, M. Suppose there are two labor types, skilled and unskilled,[7] earning wages w_S and w_U. The sum of native, N and immigrant-owned labor, M, is given by

$$x_d = N_d + M_d \qquad d \in D \equiv \{S, U\} \tag{2.3}$$

[7] This classification of two skill groups is commonly used (see, for example, Katz and Murphy (1992) and Card and Lemieux (2001). The main conclusions of the model remain unchanged if we use more than two skill groups.

in which N_d and M_d are the total native and migrant workforces of the two skill groups. Hence, assuming that the ratio of immigrant to native population, $\pi = M/N$, is small,

$$\Delta\ lnx_d \simeq \Delta\ lnN_d + \beta_d \Delta\pi \qquad d \in D \tag{2.4}$$

in which $\beta_d = M_d N / N_d M$ is the relative skill share of immigrants. The supply of labor is then $x_d l_d(w_{d,p})$, $d \in D$, x_d is number of workers of the dth type, and $l_d(w_{d,p})$ is a labor supply function. The capital is assumed to be elastically supplied at a return to capital, r, which is fixed on world markets.

Two cases regarding the number of goods produced by the economy are considered. Either the economy produces one good in quantity y_0 or two goods in quantities y_0 and y_1. The set of goods is denoted by J, which, therefore, equals {0} or {0,1}. We make two assumptions: (i) these goods are traded; (ii) the economy is small. The prices of the two goods p_0 and p_1 are, therefore, set on world markets.[8]

Assuming constant returns to scale and excluding the possibility of joint production, we write the unit cost function for the jth output as $c^j(w_S, w_U, r), j \in J$. Letting $c^j(w_S, w_U, r)$ denote the derivative $\partial c^j / \partial w_d$, demand for the dth type of labor is therefore $\sum_{j \in J} y_j c^j_d$ by Shephard's lemma.

Wages and outputs are determined by two equilibrium conditions. Firstly, the labor market equilibrium requires the equality of demand and the supply of labor. That means:

$$\sum_{j \in J} y_j c^j_d(w_S, w_U, r) - x_d l_d(w_{d,p}) = 0 \qquad d \in D \tag{2.5}$$

and secondly, firms earn zero profits and therefore

$$lnc^j(w_S, w_U, r) - lnp_j = 0 \qquad j \in J\ . \tag{2.6}$$

Considering first the case with only one output, we have

$$\begin{aligned} \Delta\ lny_0 + (\varepsilon^0_{SS} - \eta_S)\Delta\ lnw_S + \varepsilon^0_{SU}\Delta\ lnw_U &= \Delta\ lnx_S = \Delta\ lnN_S + \beta_S \Delta\pi \\ \Delta\ lny_0 + \varepsilon^0_{US}\Delta\ lnw_S + (\varepsilon^0_{UU} - \eta_u)\Delta\ lnw_U &= \Delta\ lnx_U = \Delta\ lnN_U + \beta_U \Delta\pi \\ \theta^0_S \Delta\ lnw_S + \theta^0_U \Delta\ lnw_U &= 0 \end{aligned} \tag{2.7}$$

in which $\varepsilon^0_{dj} = \partial lnc^0_d / \partial w_j$ denotes a labor demand elasticity, $\theta^0_d = \partial lnc^0 / \partial lnw_d$ denotes a factor share and $\eta_d = \partial lnl^d / \partial lnw_d$ denotes a labor supply elasticity. Hence, by substitution,

[8] In the context of regional labor markets, we need only think of p being set in inter-regional trade.

$$\Delta\ lnw_U = \frac{\Delta\ ln(N_S/N_U) + (\beta_U - \beta_S)\Delta\pi}{(\varepsilon^0_{UU} - \eta_U) - \left(\varepsilon^0_{SU} + \frac{\theta^0_U}{\theta^0_S}\varepsilon^0_{US}\right) + (\varepsilon^0_{SS} - \eta_S)\frac{\theta^0_U}{\theta^0_S}} \tag{2.8}$$

$$\Delta\ lnw_S = -\frac{\theta^0_U}{\theta^0_S}\Delta\ lnw_U \tag{2.9}$$

The negativity of the denominator in (2.8) follows from the concavity of the cost function if we assume also that $\eta_S, \eta_U < 0$. Unskilled immigration, therefore, depresses the wages of perfectly substitutable unskilled natives, and raises skilled wages. Effects on the overall mean native wages depend on the proportions of natives in the two groups. Note also that it is the change in the relative size of the native skill groups that matters to wages (given the assumptions of perfectly elastic capital supply and constant returns to scale).

Effects on employment then follow from

$$\Delta\ lnl_U = \eta_U\Delta\ lnw_U \tag{2.10}$$

$$\Delta\ lnl_S = \eta_S\Delta\ lnw_S \tag{2.11}$$

and clearly depend on the magnitude of labor supply elasticity. If η_U and η_S are zero, there are no equilibrium employment effects even if the wages are affected. In particular, there need be no equilibrium effect on the proportion of the native population employed unless labor supply responds to wage changes at the extensive margin.

Take now the case with two types of output. Considering only (2.6), we have

$$\theta^0_S\Delta\ lnw_S + \theta^0_S\Delta\ lnw_U = 0 \tag{2.12}$$

$$\theta^1_S\Delta\ lnw_S + \theta^1_U\Delta\ lnw_U = 0 \tag{2.13}$$

from which it follows immediately that $\Delta lnw_U/\Delta\pi = \Delta lnw_U/\Delta\pi = 0$. This result essentially is an implication of the factor price equalization theorem and is called the "factor price intensity". Wages are determined solely by prices through the zero-profit condition. The effects on employment are also zero in the long-run equilibrium.

Rather than affecting the wages, long-run effects of immigration are felt in the output mix. These responses can also be deduced, and follow from (2.6) given unchanged factor prices:

$$\rho^0_S\Delta\ lny_0 + (1-\rho^0_S)\Delta\ lny_1 = \Delta\ lnN_S + \beta_S\Delta\pi \tag{2.14}$$

$$\rho^0_U\Delta\ lny_0 + (1-\rho^0_U)\Delta\ lny_1 = \Delta\ lnN_U + \beta_U\Delta\pi \tag{2.15}$$

where $p_d^j = y_j c_d^j \sum_{k \in J} y_k c_d^k$ denotes a sectoral share in factor market. Therefore

$$\Delta \ ln(y_0/y_1) = \frac{\Delta \ ln(N_S/N_U) + (\beta_S - \beta_U)\Delta\pi}{\rho_S^0 - \rho_U^0} \tag{2.16}$$

and unskilled immigration leads to a relative expansion of the sector using unskilled labor relatively intensively.

For fixed levels of output, the labor market equilibrium would imply wage changes. However, these would lead to positive profits being earned in the sectors that use intensive labor types, which become cheaper. The output in such sectors would be expected to expand, driving wages back up, and long-run equilibrium will not be restored until the wages are driven back to their initial levels.

The nature of the solution, in general, depends on a comparison of the numbers of goods produced and the labor types. This observation can be generalized beyond the case of only two labor types, and can also be extended to allow for non-traded goods. The issue is the ability of the economy to respond to immigration through flexibility in its output mix. A smaller number of traded goods means that there are insufficient degrees of freedom to accommodate changes in the skill mix through changes in the output mix. The wage changes are, therefore, non-zero even in the long run. However with a sufficient number of traded goods, there is no need for immigration to induce factor price changes.

2.4 Data description

I combined two datasets provided by the IAB at the German Federal Employment Agency. The first one is the German Establishment History Panel (Betriebshistorik-Panel [BHP]), which is generated from official German employment statistics. Second, I used the Sample of Labor Market Biographies (SIAB), a 2 % representative sample of administrative social security records (the IABS) in Germany from 1975 to 2014. However, I limited my analysis to the 1990–2014 period, which experienced a steep rise in the number of immigrants. The sample, which includes more than 200,000 employment spells per year, provides precise information on the daily wages of workers, their occupation, working days, and further individual characteristics like age, education, gender, and nationality for all those individuals who contribute to the social security system. This represents about 80 % of the German workforce. Among the excluded groups are the self-employed and civil servants.[9] After excluding the observations with missing values on one of the relevant variables, the pooled sample included 7,123,479 person-year observations of 759,781 individuals.

[9] For further details about the dataset, see Antoni et al. (2016) and Schmucker et al. (2016). Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access.

The BHP is a 50 % sample of all German establishments employing at least one person, subject to social security. In total, I could identify 702,605 plants.[10] The dataset contains information about the firm's location (NUTS 3 regions), and the industry in which the establishment operates (three-digit NACE codes). Furthermore, it comprises information about the number of workers in the firm, including the nationality of the employees. The classification of foreign nationalities is very detailed, with around 180 different categories. Merging the BHP and the SIAB gives a unique data source to compute the main variables to analyze the effects of immigration at a less aggregated level. Specifically, these data make it possible to investigate the potential wage (productivity) effects of immigrant workers, which will contribute to a better understanding of the mechanisms in which the labor market faces immigration.

The IAB dataset also has some limitations in the context of my analysis, the main being that foreigners can only be identified by citizenship. Some further shortcomings arise from the wage and qualification information provided by the dataset:

(i) There is no information about the year in which the immigrants entered Germany. Because of the traditional principle of descent (jus sanguinis) in German citizenship law, naturalization rates are very low, resulting in the fact that second- and third-generation migrants often have a foreign nationality and, therefore, appear as foreigners in the sample. On August 1, 1999, a new immigration act became effective. It allows German-born children of foreign-born parents who have been living in Germany for at least eight years to decide which nationality to adopt, up to the age of 23. This has slightly increased the naturalization rate of German-born people with a migrant background (Brücker and Jahn, 2011). To mitigate the possible effects of naturalization, I have classified as foreigners all those individuals who are reported as foreign citizens in their first available spell. This prevents naturalizations from being displayed as a declining foreigner share in the final sample.

(ii) Ethnic German re-settlers are registered as Germans, as the concept of citizenship does not allow the distinction between citizens born in Germany and those born abroad. However, language courses or subsidies on the adaptation process offered to this group should facilitate their labor market integration.

(iii) The IAB has been recording data for eastern Germany since 1992. Solely concentrating on the unified Germany would exclude the main immigration shock associated with the fall of the iron curtain. German reunification also required dropping Western Berlin from the data, as mobility between Eastern and Western Berlin has been high since

[10] For reasons of convenience, I use the term "firm" instead of plant.

the fall of the Berlin Wall in 1989. Since the level and structure of wages differ substantially between East and West Germany, I focus in my analysis on individuals who were employed in West Germany (which I usually refer to simply as Germany) on September 30 of any year between 1990 and 2014. As the main geographical unit of analysis, I use 325 districts that approximate local labor markets. I do not expect the focus on western Germany to significantly affect the results, as four-fifths of the German labor force works in western Germany, and the share of foreigners is negligible in the eastern part of the country.

(iv) The dataset reports gross daily wages and does not provide information on the number of hours worked. I, therefore, excluded part-time employees (who have a "mini-job", defined as working less than 30 hours per week), trainees, interns, and at-home workers from the sample, as the wage information is not comparable for these groups. For the same reason, I excluded workers with wages below the social security contribution threshold (e.g. 450 € in 2014) because it is difficult to include them in a general analysis of earnings.

(v) There is some empirical evidence of differences in the early retirement behavior between German and migrant males (Bonin et al., 2000). I, therefore, restricted the analysis to individuals aged between 21 and 60.

(vi) The main disadvantage of the IABS is that it is right-censored, as the gross wages can only be observed up to the social security contribution ceiling. About 11 % of the employment spells in the final dataset are right-censored. This may affect the estimation of the effect of immigration on wages, particularly in the highly skilled segments of the labor market. I have, therefore, imputed wages above the social security contribution ceiling using a without heteroskedastic single imputation approach specifically developed for the IAB dataset (following Dustmann et al., 2009). To use real daily wages of workers, I deflated wages with a price index from the German Federal Statistical Office (2016) after the imputation with 2010 as the base year.

(vii) Self-employed workers and civil servants do not contribute to the social security system and are, therefore, not covered in my sample. While the self-employment rate of natives increased only slightly from about 8 % in 1991 up to around 11 % in 2014, the self-employment rate of immigrants increased from about 6 % to about 9 %. Nevertheless, the change has been moderate and it is rather unlikely that this will bias the estimation results considerably. In the case of civil servants, it seems plausible to assume that due to legal restrictions, immigrants cannot hold civil service positions (Brücker and Jahn, 2011).

(viii) The education level of the workers is provided by the employers. This means that

information on educational attainment is missing for some individuals. Foreigners are disproportionately affected by gaps in the education levels. I have, therefore, imputed the missing information on education by employing a procedure developed by Fitzenberger and Kunze (2005), which allows inconsistent education information to be corrected over time as well.

Additionally, I used an occupational classification scheme to define 12 occupational cohorts constructed by Blossfeld (1985). The objective of using this occupational classification was to represent occupational groups as homogeneously as possible by general qualification and skills, as well as by occupational duties. The occupations are grouped by hierarchical levels in the firm and by the main economic sectors (Schimpl-Neimanns, 2003). The occupational groups include, for example, agricultural laborers, mechanics, or electricians.[11] Finally, I used data from the German Federal Statistical Office (2017a) to calculate the population density of the districts to pick up agglomeration effects. This variable is measured by dividing the total population by the size of the district in square kilometers.

2.5 Descriptive evidence

Germany has one of the largest numbers of workers with a foreign nationality. Hence, it is instructive to present some facts about the migrant labor supply that may affect the labor market outcomes of natives.

Table 2.2: Descriptive statistics

Variable	Mean	Min	Max	Std. Dev.	P25	P50	P75
Log daily real wages	4.38	2.30	6.86	0.49	4.09	4.38	4.68
Share of foreigners	0.11	0	0.26	0.04	0.07	0.10	0.14
Low educated foreigners	0.27	0	0.58	0.11	0.19	0.26	0.34
High educated foreigners	0.06	0	0.5	0.04	0.04	0.06	0.09
Labor market experience	13.4	0.5	40	8.1	6.9	12.5	18.8
Log(Population/size)	6.3	3.7	8.4	1.2	5.3	6.2	7.5
No. of observations	6,336,205						

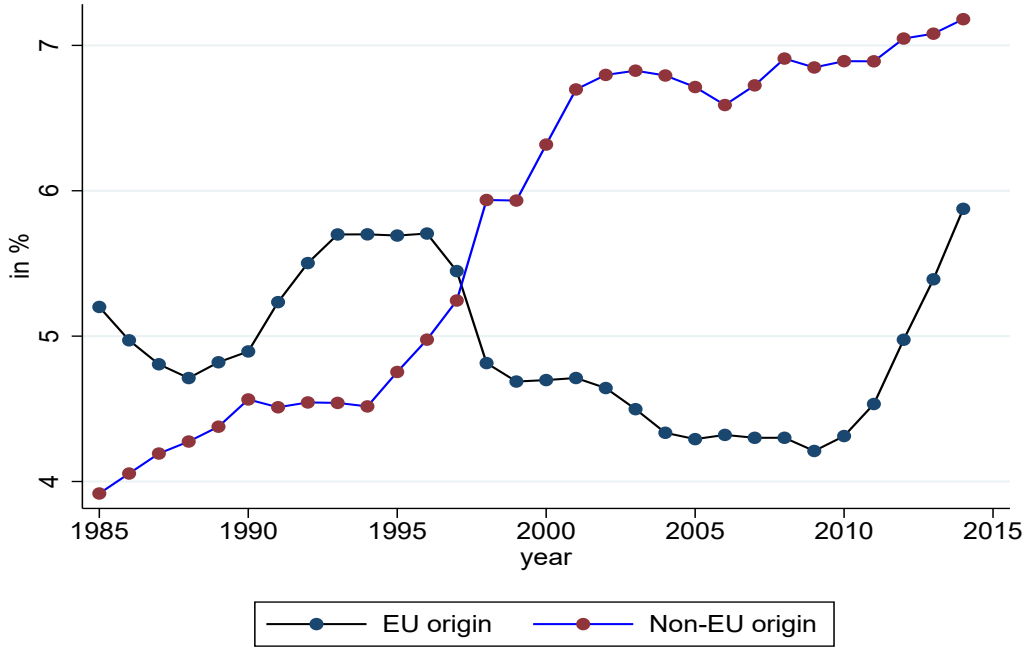
Source: Own illustration based on data from the IAB.

[11] For further information, see also Table 2.9 in the Appendix.

Table 2.2 provides some descriptive statistics, such as the mean value of the logarithm of daily real wages for native workers over the period of interest (1990–2014), as well as its distribution at different percentiles (P25, P50, and P75). Moreover, one can see the share of foreigners across education groups (high and low education).

In this context, it is important to note that the ethnic composition of immigrant inflows to popular destination countries is different: For example, immigrants in France and the UK came from the former colonies of these countries, while Germany employed immigrants primarily from southern Europe and Turkey. Figure 2.1 displays the percentage share of immigrant workers (split between the EU and non-EU nationals) in Germany as derived from the sample.

Figure 2.1: The percentage of EU and Non-EU workers in West Germany, 1985–2014



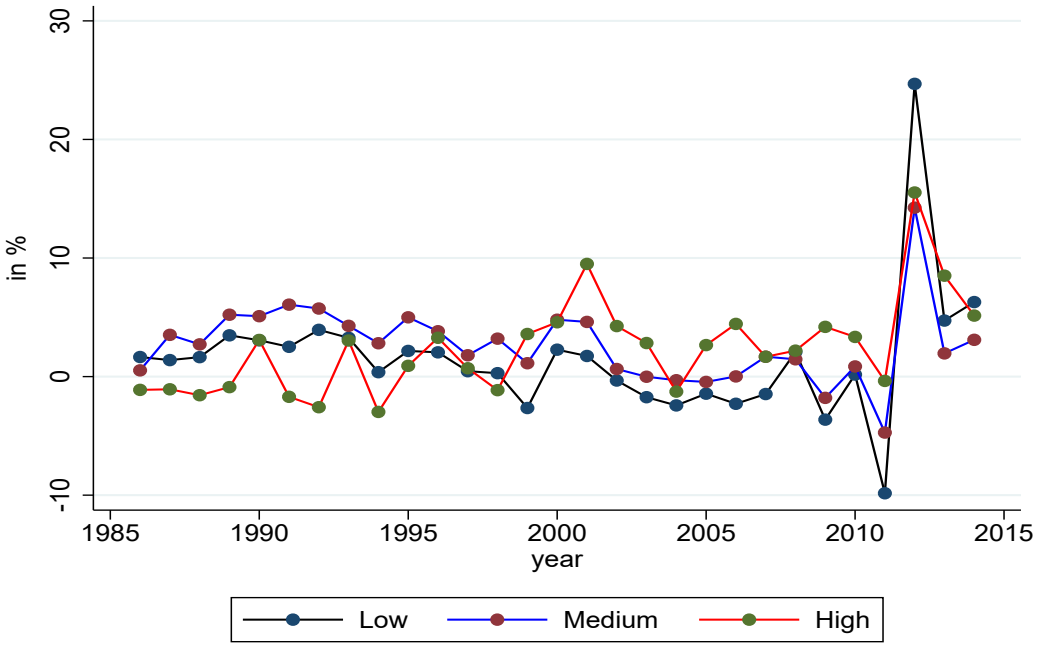
Source: Own illustration based on data from the IAB.

The share of immigrants shows some remarkable variations over time, which broadly reflects the history of net immigration flows. Between the end-1980s and the mid-1990s, the quota of immigrants in the labor force increased by two percentage points. The sharp increase in the share of foreigners in the 1990s resulted from the collapse of the communist regimes in Central or Eastern European countries and the civil wars in former Yugoslavia, which triggered large-scale migration to Germany. Since the early 2000s, the foreigner share has decreased slightly because of the slowdown in economic growth and tighter restrictions on immigration. Moreover, as foreigners tend to be more than proportionally affected by unemployment, their share in the employed workforce declined relative to their share in the labor force at the end of the millennium (Brücker and Jahn, 2011). Due to the Eurozone debt crisis, migration patterns within the Euro area have changed

fundamentally. The crisis has also caused increasing migration from the periphery to core countries like Germany. The data used for the analysis suggest that the share of foreign workers has increased over the last years, and reached a record 13 % in 2014.

For empirical analysis, it is important to have enough dispersion in the immigrant share across skill groups. Figure 2.2 illustrates this supply within skill categories, differentiated by three groups of education, and their percentage change over time.

Figure 2.2: Percentage change of share of foreign workers by education, 1985–2014



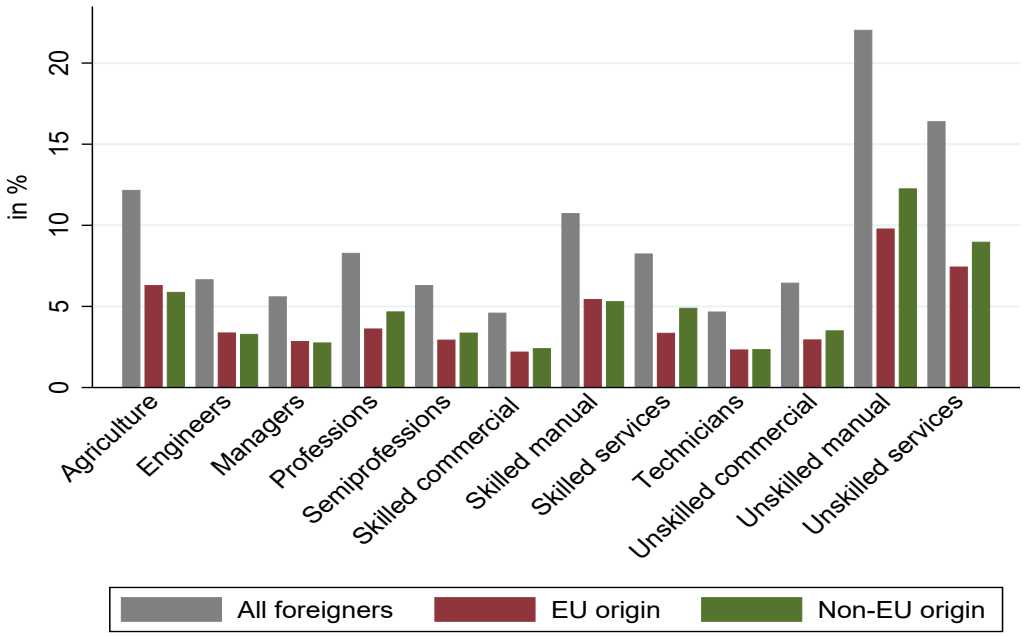
Source: Own illustration based on data from the IAB.

Workers without "Abitur (NOABI) or completed vocational training (NOVOC)" are less educated. I define workers as medium skilled who have a "completed vocational training (VOC) and/or Abitur (ABI)". Workers with a "university degree (UNI)" are considered to be highly skilled. The share of foreign workers is considerably higher among less skilled workers than medium and highly educated ones. It is clear from this picture that there is a wide variation in immigrant supply. First, these supplies vary substantially between categories of educational attainment. It is well known that in the past, immigration to Germany has greatly increased the supply of less-educated workers (up to 32 %), whereas the share of foreign workers in the upper education categories (normally less than 15 %) is much smaller. Nevertheless, if we look at the characteristics of foreigners in more detail, remarkable changes can be seen in the composition of this group. A very important issue is that the foreign citizens have become, on an average, more educated over time. Particularly since the end of the last century, there has been an increase in the share of foreign workers who have completed primary education. Moreover, the share of highly educated foreign-born workers has almost doubled in the last 30 years. The

conspicuous sharp increase of foreign participation in German labor markets in 2012 has, due to the German Federal Statistical Office (2013), three components: (1) a migration surplus (balance of arrivals and departures), (2) an excess of births (balance of births and deaths), and (3) a decrease in the number of people whose registered entries were deleted following naturalization. Most (about 80 %) of the newly-registered foreigners came from EU member states, because Germany's strong economy and good job opportunities have been a major pull for Eastern European nationals.

As an alternative measure of skills, I grouped foreign workers by their occupational status (for example, technicians, skilled services, or unskilled manual occupation), and nationality (EU and non-EU origin). The reason for this approach is that there are clear differences in wage levels and earning profiles between these occupational groups. This more disaggregated classification may provide a more satisfactory measure for the relationship between immigration and labor market outcomes of natives. In particular, to a certain extent, individuals may have a choice to move across occupations in response to an immigrant supply shock to avoid competition from immigrants. The emergence of this scenario could generate an estimation bias (Bonin, 2005). The segmentation of labor markets along occupational status can lead to different correlations between the immigrant supply shocks in an occupational group and natives' wages. Figure 2.3 provides some insight into the distribution of migrants across 12 occupation groups (the number of total occupations is 334).

Figure 2.3: Share of foreign workers by occupation groups, 1985–2014



Source: Own illustration based on data from the IAB.

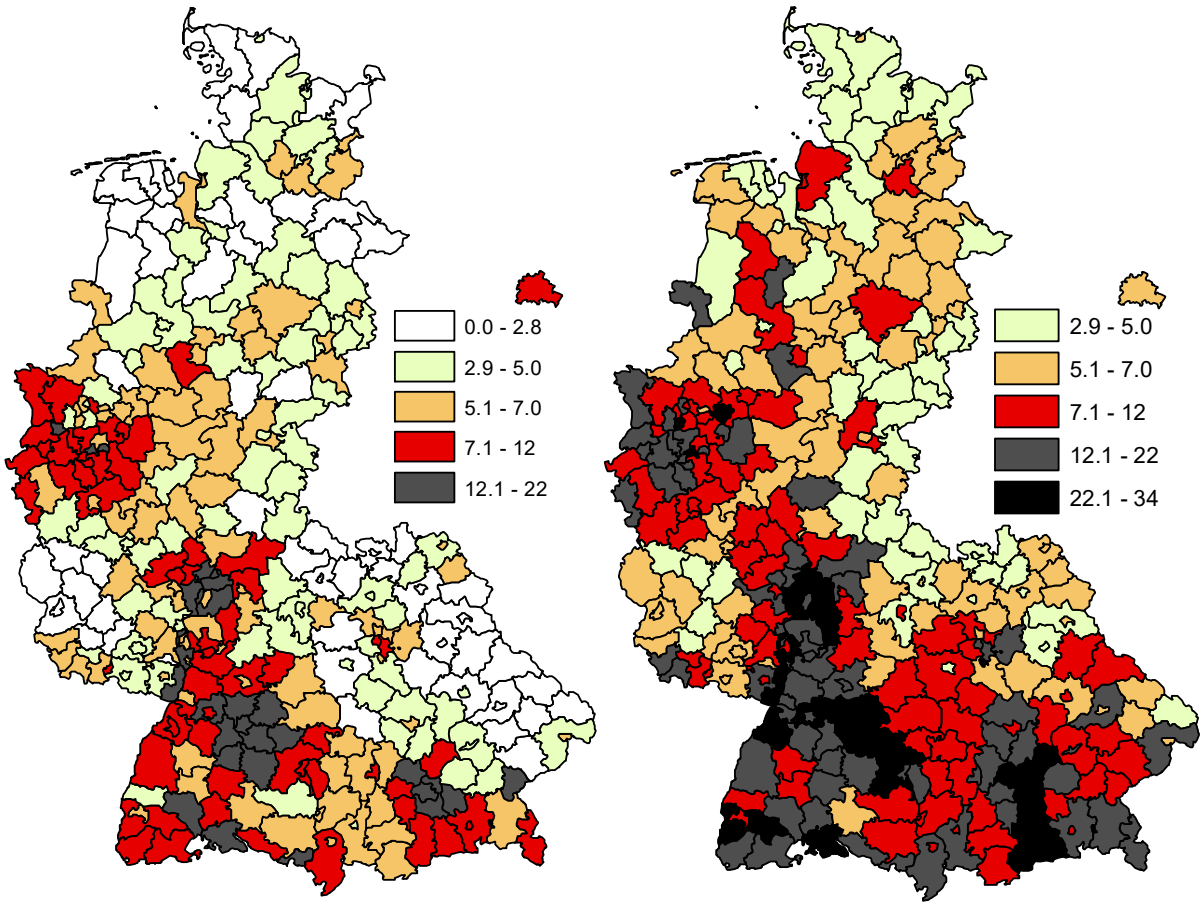
The share of foreigners in the agriculture sector with low level of educational attainment

of the workforce rose from 7.9 % in 1985 to 21.6 % in 2014. This share was, on an average, 12 % between 1985 and 2014. In 2014, 8.1 % of all managers (a profession with high skill requirements) were foreigners compared to 2.7 % in 1985. In recent years, the share of migrant labor has been the highest (over 23 %) in unskilled manual occupations, like production jobs or miners. The share of migrants from non-EU countries is slightly higher in this group than those from the EU. In addition, migrants are also strongly represented in the low-skilled service sector (with an average share of about 17 %). Cleaners typically belong to this category.

In Germany, the geographical distribution of immigrants has some specific features, though the degree of concentration is different from that in the USA or Canada. It is important to address the question "Where do immigrants live?" In general, migrants are disproportionately attracted to the larger urban areas with better economic performance. Figure 2.4a and Figure 2.4b show the spatial concentration of foreign workers across German districts for 1985 and 2014.

Figure 2.4: Share of foreign workers in West Germany

(a) 1985 **(b)** 2014



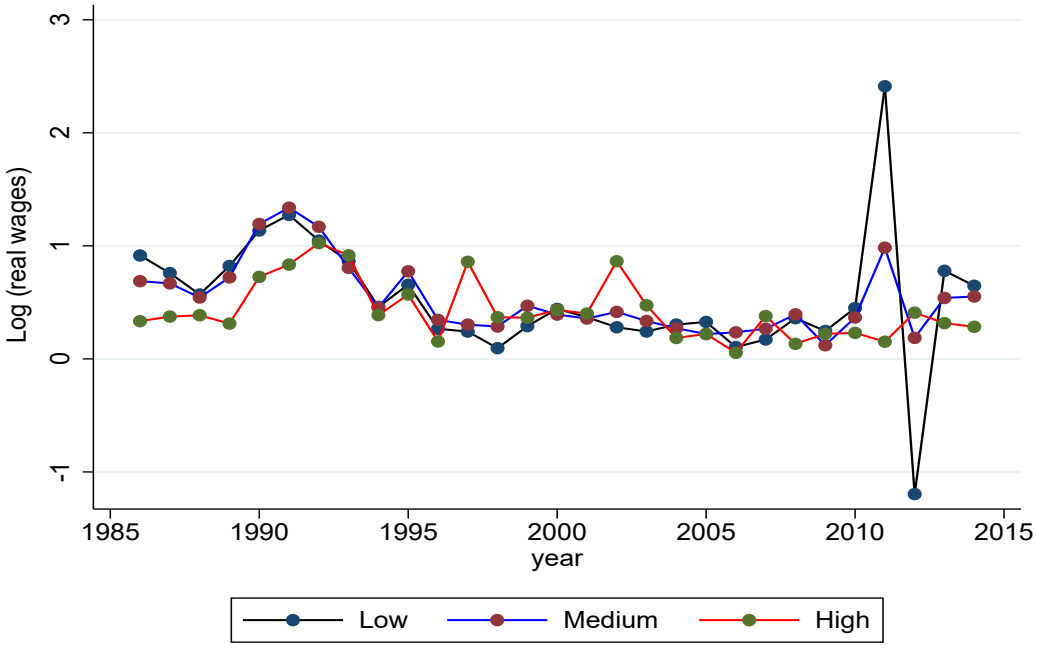
Source: Own illustration based on data from the IAB.

It is obvious that they are unevenly distributed across the regions. The areas indicated

with darker shades have a greater proportion of immigrant workers. In some areas, the share of immigrant workers is about 25 %. In fact, the regions with a high proportion of migrants in 1985 are also those which show a similar pattern 30 years later. The districts with the highest values are around Munich, Stuttgart, and Frankfurt, as well as in the Rhine-Ruhr area. It is also clear that the share of foreigners is particularly high in the economically well-developed regions. This would confirm the theory that migrants are predominantly represented in regions with a high economic activity. As a consequence, immigrants contribute to urban population growth, and thereby strengthen the forces of agglomeration. Certainly, one has to be very careful in drawing causal inference from visual-based statistical association. Nevertheless, the very uneven distribution of immigrants across districts makes for a very good "prima facie" setup to examine the differential impact of immigration on the local economies. It should also be noted that these two maps are useful to illustrate the basic idea of the identification strategy, which will be discussed in the next section.

Coming to labor market outcomes, natural differences in wages were experienced by the various education groups in the last decades. Figure 2.5 displays the percentage change of the logarithm of the mean daily real wages of native employees for the three different levels of educational attainment.

Figure 2.5: Percentage change of wages of natives by education groups, 1985–2014



Source: Own illustration based on data from the IAB.

There is a great deal of variation in the rate of wage growth by education. It is noteworthy that the changes in the education-earnings profiles observed in the German data are different from the developments in the returns to skills which have occurred since the

1980s in other countries, notably in the US (Hanushek et al., 2015). For instance, the earnings of less educated workers grew relatively faster (about 16 %) than that of workers with an academic education (about 13 %) in the considered period. In sum, the data show that immigration did not have a balanced impact on the supply of workers in the segments of the labor markets defined by education. At the same time, there seems to be a significant distinction in labor market outcomes within education cells. Therefore, in principle, there seems to be sufficient independent variation in the data to estimate the labor market impact of immigration on natives.

2.6 Estimation approach

The model outlined in section 2.3 suggests a relationship between the labor market outcomes and the share of immigrants in the labor market. The estimation specification I adopted follows from (2.9), (2.10), and (2.11), but with one extension. The focus is on the labor market outcomes of individuals instead of the average value in the local labor markets. More precisely, my empirical analysis is based on a linear regression model that refers to the labor market outcome y_{idt}^{NAT} (such as daily wages) of native individual i $(i = 1, \ldots, N)$ residing in district d $(d = 1, \ldots, D)$ at time t $(t = 1, \ldots, T)$ to a vector of time-varying individual-specific characteristics X'_{idt} (such as years of education, occupation or labor market experience), district features Z'_{dt} (like the characteristics of local labor markets and the population density).[12] More specifically, the regressions I estimate have the following structure:

$$y_{idt}^{NAT} = X'_{idt}\beta_1 + Z'_{dt}\beta_2 + \beta_3 S_{dt} + \gamma_i + \varphi_{area} + \delta_t + \varepsilon_{idt} \tag{2.17}$$

In equation (2.17), the parameter γ_i stands for individual fixed effects to control for time-constant heterogeneity among workers, i.e. to mitigate the omitted variable bias. The variable φ_{area} describes the settlement structure of the area. A distinction is made between four classifications: (1) large districts, (2) districts, (3) rural districts with a density tendency, and (4) sparsely populated rural areas.[13] The a priori expectation is that people who work in urban areas earn more on an average, which probably reflects a higher cost of living. Furthermore, the model contains time fixed effects δ_t which rule out time-specific trends. Finally, ε_{idt} is a normally distributed residual term. In sum, I compared labor market outcomes of natives where immigrants are a substantial fraction of the labor force (for example, Munich or Frankfurt) with natives' labor market outcomes

[12] The purpose of the control variables (X'_{idt}) is to capture alternative factors that determine or are correlated with local labor market outcomes. Their inclusion effectively increases the comparability of different districts and, hence, their ability to serve as valid counterfactuals.
[13] The results are almost identical if I consider district instead of area fixed effects.

in the districts in which immigrants are a relatively small fraction (such as Dithmarschen or Coburg). The key variable S_{dt} measuring the share of foreigners in the labor force of a district is defined by:

$$S_{dt} = M_{dt}/(M_{dt} + N_{dt}) \tag{2.18}$$

in which M_{dt} represents the number of immigrant workers [14] in district d and year t, and N_{dt} denotes the corresponding number of natives.

After including different sets of fixed effects, the parameter β_3 in (2.17) captures the changes in the outcome variable that happen due to the changes in the share of foreigners in the observed area. But this estimator is only conclusive under the usual assumption that, after controlling for the fixed effects and demographic characteristics, the variation of the share "foreign-born" is exogenous and not driven by unobserved factors. Another associated problem is the potential measurement error in the computation of immigrant shares at the district level which can cause biased OLS estimators. For these reasons, research in this area is related to some challenges.

Initially, one important reason for the different performances of labor markets across locations could be the divergent successes of different industries over the last decades. Particularly, the information and communication technology revolution has increased the productivity of the high-tech sectors in manufacturing and services a lot. As a consequence, their demand for workers, especially of the relatively young and the highly educated ones, has surged. But a part of the economy, which is characterized by simple, routine, and non-cognitive type of occupations, has experienced stagnant wages and employment. Since geographical areas are unequal due to specialization, some have lost welfare from the decline of low-performing industries while others have benefited more from the expansion of fast-growing sectors (Basso and Peri, 2015). In this context, I used the different industry structure of districts for the considered period and the evolution of wages across those industries to construct an index that captures local sector-driven labor demand growth. Subsequently, I include this covariate in the regression equation (2.17) to test if the (positive) correlation between immigrants and labor market outcomes survives. The proxy for industry-driven growth in the labor demand (LD) for workers in district d can be computed as follows:

$$LD_{dt} = \sum_{j} \left[sh^{EMPL}_{dj,1985} log(wage)_{jt} \right] \tag{2.19}$$

[14] I used 47 nationalities to compute M_{dt}. Immigrants from Turkey are the largest ethnic group in Germany. Other countries from which many foreign workers come include Italy, former Yugoslavia, Greece, and Poland.

where $sh^{EMPL}_{dj,1985}$ is the share of employees in industry j, at the district (d) for the base year 1985, $log(wage)_{jt}$ is the logarithm of mean wages in industry j and year t.

Certainly, a more relevant identification issue is the potential endogeneity of the share of foreign-born workers. Unbiased coefficients of equation (2.17) can only be estimated if immigrants are randomly allocated across regions. This, however, seems unlikely. For example, immigrants tend to cluster in particular states or cities. There are two potential reasons for non-random allocation of immigrants across local labor markets. First, they might be attracted to areas that are experiencing economic growth and providing more job opportunities. Hence, immigration is also endogenous to local labor market conditions. The concern is that this endogeneity creates the problem of simultaneity bias in the estimates of the coefficient β_3. If immigrants settle in areas where wages are higher, the correlation between wages and immigration is the result of the simultaneous influences of each variable on the other. The solution is to cut the line of causality from the wage to the immigrant variable (Bodvarsson and Van den Berg, 2013).

Another source of bias is that immigrants sort themselves into cities, in which people with the same ethnic or cultural background already reside. According to the network theory, rooted networks reduce the costs and risks of movement for new immigrants, making it easier for them to find a place to live, a source of employment, and a community from which they can draw support. Economic literature on migration provides evidence supporting this prediction (Taylor et al., 1989; Massey, 1990; Pedersen et al., 2008). If the areas coincidentally experience persistently soft or strong labor markets, we estimate a spurious correlation between y^{NAT}_{idt} and S_{dt}, even though immigration has, in fact, only a weak direct influence on the dependent variable. In addition, if immigrants decide to settle where earlier immigrant cohorts have already established immigrant enclaves, and those areas also have relatively low wages for reasons unrelated to immigration per se, β_3 will be biased downwards and, thus, overestimate the true impact of immigration. This bias is caused by the fact that the regression fails to account for the influence of previous immigrants' settlement patterns on the variable share of foreigners. In the literature, mainly two approaches address the endogeneity of the location choice of migrants, either by using quasi-experimental evidence from placement policies (Edin et al., 2003; Glitz, 2006; Foged and Peri, 2016) or by employing IV strategies using the lagged share of migrants as an instrument for the current share of migrants (Altonji and Card, 1991; Danzer and Yaman, 2010).

Another possible solution for the identification of the causal effect of immigrants on native labor market outcomes, apart from controlling for demand changes, is to construct a proxy for the supply-driven shifts of the migrant population. More precisely, I sought an external IV correlated with the change in the share of foreigners of districts in the

considered period, but which was not correlated with any district-specific shocks. This strategy, based on the Card (2001) shift-share instrument, has been frequently used in studies that focus on the impact of immigrants at the aggregate level (Card, 2005; Ottaviano and Peri, 2006). I exploited this shift-share methodology to predict the current share of foreign workers based on immigrants' past location choices. For example, Bartel (1989) has empirically shown this tendency of new immigrants to move to enclaves established by older immigrant cohorts of the same country. In fact, her analysis suggested that the existing ethnic or cultural concentration in an area is the most important factor for the location choice of new immigrants.

The aim was to remove the effect of unobserved demand shocks that might affect location choices. The used data also confirm that the share of immigrants with a certain nationality in a district is an appropriate predictor of where new immigrants with that culture will settle in the future. Under the assumption that unobserved factors determining historical settlements are uncorrelated with current economic conditions within each cell, we can obtain an exogenous measure for the share of immigrant workers. In other words, the IV technique isolates, for a given labor demand, the part of immigration driven by supply choices of migrants and tracks its effect on the outcome variable.

As mentioned above, since migrants prefer to settle near other migrants of the same nationality who arrived in earlier periods, the presence of older communities is used to predict immigrant supply shifts. The response of the dependent variable can be tracked, for a given labor demand, when only the labor supply changes due to immigration. For each district, I used the share of immigrants from a specific culture (i.e., foreign nationality) in 1985 to predict the share between 1990 and 2014 by allocating the national growth rate of that culture to the initial district level as follows:

$$\widehat{S_{dt}} = S_{dt=1985}[1 + g_{,1985-t}] \tag{2.20}$$

in which $\widehat{S_{dt}}$: is the estimated share of migrants in district d in year t 1990,...,2014 (observation period); $S_{dt=1985}$ is the stock of migrants in district d for the base year 1985; and $g_{,1985-t}$ is the overall national growth rate of the share of immigrants between 1985 and year 1990,...,2014. Not only does this IV have the advantage of exploiting the country of origin of immigrants, it also helps by using a larger sample to solve the potential measurement error problem.

While analyzing the effects of aggregate variables on micro units, we have to account for the possibility of a within-group correlation of random disturbances to obtain fully robust standard errors. Since individuals living in the same local labor market share the same observable characteristics on an aggregate level, they may also share unobservable attributes that lead to correlated errors. As a result, the standard errors of the parameter

estimates may be biased downward (Bauer et al., 2013). This, in turn, reduces the power of statistical tests, and the probability of mistakenly accepting the null hypothesis increases. In my empirical analysis in the next section, I estimate cluster-robust standard errors at the individual level to avoid this concern.

2.7 Estimation results

This section reports and discusses the estimated effects of immigration on the labor market outcomes of native workers. Table 2.3 shows the estimates of the basic linear wage regression with individual and regional characteristics using different econometric methods.[15] The results indicate that the share of foreign workers in districts has a positive significant impact on the wages of native-born workers. The estimator in column 1 suggests that a percentage-point increase in the share of immigrant workers is associated with a native wage growth of 0.594 %. The magnitude of this effect is modest because it measures a percentage point change in the immigrant share. For example, suppose the share of immigrant workers increases from 5 to 6 % (an increase of 20 %), and the wage is predicted to rise by 0.6 %. Then, a 10 % increase in immigrant share implies only a 0.3 % increase in daily earnings. Bauer et al. (2013) found no evidence of a wage-depressing effect of immigration in Germany. They estimated a coefficient of a similar magnitude — 0.499 — for the variable share of foreigners in the labor force, though there were differences in the specifications, and the assumptions being made about the immigration effect. This result could indicate that natives and foreigners are complements in the labor market.

Basso and Peri (2015) presented in their recent paper casual correlations between immigration and labor market outcomes of native workers in the US. They used data on local labor markets over the 1970–2010 period. A fact that emerged from all the specifications was that the net growth of immigrant labor has a zero to positive correlation with changes in native weekly wages, in aggregate and by skill groups. The authors estimated a significantly positive correlation coefficient around 0.4.

Furthermore, OLS underestimates the impact of immigration on the earnings of natives because the IV-FE estimator [16] is about 48 % larger. Since the IV method explicitly tries to account for potential bias, its results are probably more reliable in this case. The first stage of the IV regression indicates that, as expected, the shift-share instrument is positively correlated with the endogenous regressor share of foreigners. The F-test always yields a value that is much larger than the lower bound of 10 suggested by the literature on

[15] Occupation is included in the regression as a control variable. For reasons of clarity, the estimators are omitted in Table 2.3. These results are available from the author on request.
[16] All first-stage estimates are available upon request.

weak instruments (Stock and Yogo, 2002). Moreover, the Kleibergen-Paap rk F-statistics also confirm that my instrument is strong, regardless of the specification mode.

Table 2.3: Regression results for Equation (2.17) – Explaining native wages

Regressor	**OLS**	**FE**	**IV-FE**
Share of foreigners	**0.594*****	**0.622*****	**0.881*****
	(0.011)	(0.005)	(0.008)
Female	-0.329***		
	(0.001)		
Education in years	0.049***	0.014***	0.014***
	(0.0002)	(0.0001)	(0.0001)
Labor market experience	0.026***	0.046***	0.045***
	(0.0001)	(0.00005)	(0.0005)
Labor market experience^2	-0.0004***	-0.0006***	-0.0006***
	(0.000004)	(0.000001)	(0.000001)
Log(population/size)	-0.011***	0.009***	0.006***
	(0.0004)	(0.0004)	(0.0004)
Labor demand index	0.068***	0.003***	0.003***
	(0.002)	(0.0006)	(0.0007)
Share of low skilled	-0.107***	-0.131***	-0.159***
	(0.009)	(0.003)	(0.003)
Share of high skilled	1.187***	0.207***	0.175***
	(0.009)	(0.004)	(0.004)
Share of young workers	-0.904***	0.188***	0.203***
	(0.007)	(0.003)	(0.003)
Individual fixed effects		✓	✓
Area fixed effects		✓	✓
Time fixed effects		✓	✓
R^2	0.507	0.449	0.449
Number of observations (N):	6,336,205	6,336,205	6,336,205

Note: Heteroskedasticity robust standard errors in parentheses.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

The coefficients of the individual socioeconomic characteristics of the wage regression presented in Table 2.3 have the expected signs. It can be observed to be positive but as decreasing returns to potential labor market experience; women receive lower wages, and educated persons have significantly higher wages. Moreover, the demographic composition of the labor force or the characteristics of the local labor market, like population density,

have a significant effect on the wages of native persons.

Considering immigrants as one group and focusing only on their uneven geographic distribution cannot by itself provide the full story about their economic impact on natives. Immigrants, in fact, are presented differently than natives across skill groups. Hence, the specific skill distribution of immigrants should be taken into account. For one thing, it provides us with another dimension of variation to analyze the effect of immigrants. As noted in the Descriptive evidence section, a noticeable feature of the German immigration experience is its highly unequal regional impact. What was even more relevant for my analysis, the skill composition of the inflows of foreign-born workers also varied across regions. As a result, districts that received large inflows were also the ones with a significant increase in the relative supply of unskilled labor. Moreover, some of the surveyed studies found a more significant negative effect on the wages of less educated native workers than native workers overall. The hypothesis is that the size of the wage reaction will depend on the degree of substitutability across skill groups, as well as between immigrant and native workers with similar skills (Longhi et al., 2005). Table 2.4 reveals only the estimates of the coefficient of interest, namely, β_3 in equation (2.17) on the wages of natives by education groups.

Table 2.4: IV-FE results – Explaining native wages by education groups

natives: / foreigners:	low	medium	high	total
low	0.451***	0.383***	0.246***	0.349***
	(0.010)	(0.004)	(0.009)	(0.003)
medium	1.546***	1.360***	0.887***	1.239***
	(0.033)	(0.013)	(0.031)	(0.011)
high	4.919***	3.759***	2.427***	3.436***
	(0.139)	(0.043)	(0.090)	(0.036)
total	1.110***	0.964***	0.641***	0.881***
	(0.024)	(0.009)	(0.023)	(0.008)
N	1,013,286	4,612,048	710,871	6,336,205
R^2	0.362	0.467	0.457	0.449

Note: Heteroskedasticity robust standard errors in parentheses.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

I did not identify any significant differences regarding the sign of estimators between the less educated and all native workers. However, according to the IV-FE method, the share of highly educated foreign labor force had a stronger positive effect on the wages of native workers along all the skill levels compared to the less and intermediately educated foreigners. While an increase in the number of low-skilled immigrants by one

percentage point was associated with a 0.451 % increase in less educated native wages, highly educated natives showed a 2.427 % growth of wages. This is in line with an overall positive demand (productivity) change or of positive externalities (like knowledge spillovers) associated with immigrants. Several studies have supported the hypothesis that cultural diversity induced by the inflow of foreigners in a region increases the productivity of natives (Ottaviano and Peri, 2006; Trax et al., 2015). If part of this association is causal, it would be consistent with a stronger complementarity effect of immigrants on highly educated natives. Another strand of literature has found that highly skilled immigrants are likely to boost firm productivity and the wages of native workers in the long term by stimulating firm growth and contributing a mix of skills and ideas (Kerr and Lincoln, 2010; Hunt, 2011). These mentioned economic channels may explain why the wage effect is more pronounced among highly skilled natives.

It has been argued that minimum wages or social security levels could prevent the wages of native-born workers from falling, and immigration could have adverse employment effects (Bauer et al., 2013). Table 2.5 provides the estimated effect of the immigrant share on the employment of competing native workers.

Table 2.5: IV-FE results – Explaining the employment of natives by education groups

natives: / foreigners:	low	medium	high	total
low	0.311***	0.860***	1.508***	0.737***
	(0.024)	(0.012)	(0.029)	(0.010)
medium	1.551***	1.108***	1.960***	1.409***
	(0.045)	(0.018)	(0.029)	(0.046)
high	1.955***	2.110***	3.529***	2.509***
	(0.036)	(0.017)	(0.090)	(0.015)
total	1.310***	2.207***	2.953***	1.892***
	(0.065)	(0.031)	(0.077)	(0.027)
N	1,013,286	4,612,048	710,871	6,336,205
R^2	0.567	0.508	0.751	0.557

Note: Heteroskedasticity robust standard errors in parentheses.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

For each specification and dependent variable, I report the IV-FE-estimated coefficients on the immigrant share. In this respect, too, I identified no adverse effect of immigration on the employment probability of all education groups of natives. There is a clear pattern of the correlation between immigrant supply and the employment of natives. Again, I observed a stronger positive effect of highly skilled immigrants on the employment probability of natives with a similar skill level. This suggests that immigrants constitute

complements for highly skilled native-born workers in the German labor market.

What is also conceivable is that the migrant's country of origin can be relevant regarding the impact on the labor market. First, it is argued that the geographical proximity between the sending and destination countries fosters immigration flows. Second, foreigners from culturally closer countries (due to particular historical reasons) to the host country are confronted with fewer barriers to integrate because they have lower transaction and communication costs. For example, Italians are culturally closer to Germans than the immigrants from Turkey. In addition, Italians have to cross a shorter geographical distance to enter Germany. More importantly, they face no restrictions on residence or employment in Germany. According to these inferences, immigrants with stronger cultural ties to natives have more German-specific human capital skills (not exclusively related to language skills). Therefore, all else being equal, one would expect an increase in the share of foreign-born workers with cultural similarity to the host country employees to have a stronger impact on the labor market outcomes of natives than a similar increase in the share of foreign-born workers who are culturally less related to native workers.

I split the share of foreign workers into two groups: foreigners from the EU and those from non-EU countries. The assumption is that immigrants from the EU are culturally and linguistically closer to Germans than the immigrants from the non-EU countries. To the best of my knowledge, this aspect has been neglected in the existing literature for Germany. Table 2.6 shows that contrary to expectations, the wage impact of immigrants from the EU member states did not appear to be dramatically different from the rest of the world.

Table 2.6: IV-FE results – Explaining native wages by the country of origin

natives: / foreigners:	low	medium	high	total
EU	1.451***	1.054***	0.580***	0.915***
	(0.027)	(0.011)	(0.029)	(0.009)
Non-EU	0.310***	0.621***	0.589***	0.625***
	(0.043)	(0.018)	(0.048)	(0.016)
N	1,013,286	4,612,048	710,871	6,336,205
R^2	0.362	0.467	0.457	0.449

Note: Heteroskedasticity robust standard errors in parentheses.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

With the exception of highly educated natives, the wages of other natives are slightly more strongly affected by migrant workers from the EU. But the idea that immigration from the EU is the main driver of the increase in wages paid to native-born workers is

simply not supported by the available evidence.

The spatial approach is often criticized for the potential bias that is inherent due to the endogenous nature of immigrants' decisions about where to reside and the economic opportunities of local areas. I propose a contrasting method to deal partially with this concern. The decisive difference lies in the consideration of occupations as the unit of analysis. Compared to the skill groups, occupations are at a disaggregated level, which can be treated as an alternative measurement for the investigation. As Steinhardt (2011) highlighted in his paper, German immigrants and natives with similar education and experience are likely to work in different occupations.

After controlling for the relevant factors, I again found a positive effect of the total number of immigrant workers on the wages of natives, regardless of which one of the 12 occupation categories under examination was considered. These results are statistically significant and similar in magnitude, as previously identified, and do not support the notion that immigrants lower the wages of native workers. In fact, the opposite was the case. Table 2.7 illustrates that the wages of natives in the occupational groups with high educational requirements (like engineers or professors) are most strongly (positively) influenced by immigration. In this case too, highly educated migrants were the ones who drove up the wages of the natives.

However, if we look at the effects of migrants from the EU and non-EU countries separately, it can be seen that natives in some occupational categories (agriculture, technology, skilled services, and unskilled commercial) experience depressing wages with increased migration from non-EU countries. This can be attributed to the fact that natives and foreigners in these occupational groups are regarded as substitutes. Since most immigrants are low skilled (relative to natives), and low-skilled jobs are more likely to involve manual tasks, the increased number of immigrants could partly crowd out natives from employment.

Furthermore, occupations that are concentrated in low-skilled sectors, such as agricultural work, may require less interpersonal skills. Immigrants with poor language proficiency and weak communicational skills might have a negative effect on the wages of natives in these occupations, because immigrants may accept lower wages when they come to the host country because they are used to receiving lower wages in their home countries. The results show that it is important to distinguish between the effect of immigration on the average wage of all workers in the economy, and on the wages of different groups of workers along the wage distribution (e.g. low, medium, and highly paid workers). Similarly, specific subgroups of migrants can lead to different effects on the labor market outcomes of native-born workers than the total share of foreigners.

Table 2.7: IV-FE results – Explaining native wages in occupation groups

Explanatory variable:	share of foreigners				
Occupation	Total	EU	Non-EU	N	R^2
Agriculture	0.969***	0.780***	-1.210*	69,888	0.301
	(0.107)	(0.105)	(0.649)		
Unskilled manual	0.653***	0.729***	0.266***	877,058	0.505
	(0.011)	(0.012)	(0.022)		
Skilled manual	0.954***	0.894***	0.768***	1,090,768	0.501
	(0.015)	(0.015)	(0.034)		
Technicians	1.525***	2.436***	-0.935***	424,923	0.501
	(0.071)	(0.137)	(0.227)		
Engineers	3.723***	2.822***	1.584***	259,043	0.342
	(0.304)	(0.303)	(0.374)		
Unskilled services	0.567***	0.744***	0.220***	674,672	0.323
	(0.014)	(0.018)	(0.025)		
Skilled services	1.085***	2.147***	-0.890***	250,187	0.273
	(0.054)	(0.085)	(0.116)		
Semiprofessions	1.756***	2.216***	1.118***	341,830	0.458
	(0.064)	(0.077)	(0.279)		
Professions	3.817***	2.535***	3.818***	102,984	0.356
	(0.581)	(0.751)	(0.631)		
Unskilled commercial	1.112***	1.181***	-0.168*	446,817	0.375
	(0.053)	(0.079)	(0.093)		
Skilled commercial	1.693***	3.052***	0.401***	1,478,368	0.491
	(0.037)	(0.070)	(0.063)		
Managers	1.831***	1.582***	1.992***	235,762	0.281
	(0.217)	(0.402)	(0.697)		

Note: Heteroskedasticity robust standard errors in parentheses.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

In summary, my results suggest that, for a given size of the group of foreign workers, immigration had a significantly positive effect on employment or wages between 1990 and 2014, despite considerably altering regional skill distributions. There is also no indication that immigration had an effect on inequality by reducing the wages and the employment of low-skilled native workers.

2.8 Robustness checks

To check the sensitivity of my results, I explored the same model specifications shown in the previous tables, but I focused on different groups of natives and foreigners. As an important robustness check, I considered the wages of different demographic groups as the dependent variable. I quantified the effects of immigration on males, females, and young workers. I defined the last groups as those below 31 years. This category included about 26 % of natives in my dataset. Winter-Ebmer and Zweimüller (1996) used the spatial approach, as well as an alternative strategy that segments the national labor market across industries, to study the impact of immigration on the average wages of young Austrians. Both methodologies show that immigration had a positive impact on natives' wages.

My IV-FE results yield the same essential conclusion of a positive wage effect of immigration. However, the estimate in terms of female and young native workers are slightly more positive than the other group, as shown in Table 2.10 (see in the Appendix). For example, the coefficient for females is 1.071, but while using the male workers, the coefficient becomes 0.801. Regarding the other covariates in Table 2.10, the positive net effects are, for example, estimated for education, experience, or labor demand index. A negative net effect was evident for all workers, when the share of low-skilled workers in the areas increased. As an additional sensitivity test, I also investigated the effect of total, EU, and non-EU immigrants on the wages of male natives in the occupation groups. The results in Table 2.11 (see in the Appendix) indicate that the proportion of immigrants from the EU had, in most cases, a stronger positive effect on the wages of natives in occupational groups than the proportion of immigrants from a non-EU origin did. Indeed, migrants from non-EU countries had a negative impact on the wages of male natives in the agricultural, technical, and skilled services sectors. These findings are consistent with the view that EU foreigners are closer complements to native workers, whereas immigrants from non-EU countries substitute natives in three industries. A one percentage point increase in the proportion of immigrants of a non-EU origin reduced the daily wages for male native workers in the agricultural sector by 0.480 % after controlling for the other variables.

2.9 Conclusion

There is a consensus among researchers that, broadly speaking, rising immigration has no detrimental labor market consequences for native workers. In my comprehensive investigation, I used a unique dataset to compare between two alternative analyses, namely, the spatial approach and the occupational approach, to identify the effects of immigration on the German labor market. The results yielded, to a large extent, similar conclusions. The

spatial approach suggested positive consequences of immigration. This finding was valid for different individual skill-levels, in the aggregate, and when either employment or wages was used as the dependent variable. The estimates of my alternative approach indicated that the higher the proportion of migrants in occupational groups, the greater the increase in the wages of native workers. My estimates on the direct within-occupational effect of the share of immigrant workers were not extremely large; if the share of migrants in the 12 examined occupational groups increased by 1 percentage point, the wages of natives rose between 0.6 and 3.8 %. The main difference between the two approaches lay in the fact that this conclusion changed when different subgroups (EU and non-EU origin) of foreigners were used. The occupational approach revealed a negative effect on the daily wages of native workers if the share of foreigners from the non-EU countries in particular occupational groups increased. According to empirical evidence, it seems more reasonable to consider different occupational groups in addition to the skill dimension.

I tried to rule out spurious determinants of this correlation by including some measures. First, I calculated an index of local industry structure to control for different levels of economic performance and labor demand growth in regions. Second, I used common geographical factors, but the correlation did not change too much. Certainly, I could not take all the relevant factors into account. Nevertheless, these results, with both a large number of observations and a rich set of controls, helped us to comprehend how immigrant-induced supply shocks affect wages and the employment of natives at the local level.

To cope with potential endogeneity of the share of immigrants, I constructed a suitable instrumental variable based on the shift-share instrument. I exploited information on the location patterns of previous immigrants as instruments to predict immigrants' settlement choices in the future. This instrumental variable technique shows only a small change in the point estimates of the correlation between immigrants and the labor market outcomes of natives. However, it can be observed that the precision of the OLS estimates deteriorates significantly. When controlling for non-random sorting of foreigners into certain labor markets, the IV estimator suggests that an increase in the number of immigrants by 1 percentage point of the initial population in a district is associated with a native wage growth of 0.881 %. This result is in line with earlier studies for Germany which found small or no effect of immigration on the wages or the employment of German natives. I also showed that this positive correlation holds across demographic groups. It is (slightly) higher among women, young people, and workers with a university degree compared to men, old people, and less skilled workers respectively. It is particularly evident that natives may benefit from highly skilled immigrants.

Future research might investigate whether there may be some accumulation or accel-

eration of the effects, as the share of foreigners continues to rise. Finally, future research should also consider the impact of recent immigration on the wages of earlier immigrants who came to Germany. The association may be substantial if the labor market competition between these groups is more direct. A key observation is that there are large differences between the main countries of origin regarding previous and new immigrants. Over the last years, Syrian nationals have been the main group of asylum seekers, followed by Afghan and Iraqi nationals. These new people, with different skills, ethnic or cultural backgrounds, can affect the labor market outcomes of natives or earlier immigrants differently. New immigrants may be stronger labor market competitors of earlier immigrants than of native workers.

2.10 Appendix

Table 2.8: Labor market and immigration data

Issue	**Description**
Data source	The Sample of Integrated Labour Market Biographies (SIAB) and the German Establishment History Panel (BHP), which is generated from official German employment statistics
Data characteristics	Administrative register data
Sample size	2 % sample of all wage and salaried employees (SIAB) and 50 % sample of all German establishments employing at least one person subject to social security, thus excluding civil servants and self-employed individuals (BHP)
Sample period	1990-2014
Sample coverage	Full-time employees
Definition of nationality	A worker is considered as German if her/his nationality is German and if s/he has always worked in Western Germany. All the others are considered as immigrants. Eastern or ethnic Germans are identified as individuals with a German nationality who started working in the East or abroad and then moved to the West within the considered period. Foreign migrants are individuals without German nationality, at least in one observation. Moreover, foreign citizens are corrected for naturalization
Definition of full-time work	Reported by employers (reference is usual working time in the establishment)
Definition of wages	Daily wages deflated by CPI (2010 prices); daily wages above social security contribution ceiling are imputed
Education classifications:	
Low	No vocational training or Abitur
Medium	Vocational training degree or Abitur
High	University degree
Work experience	In years

Source: Own illustration based on Brücker and Jahn (2011).

Table 2.9: Classification of occupations by Blossfeld

Occupational group	Description	Examples
Agriculture	Occupations with a dominant agricultural orientation	Farmers, agricultural workers, gardeners, workers in the forest economy, fishermen
Unskilled manual	All manual occupations that showed at least 60 % unskilled workers in 1970	Miners, rock-breakers, paper-makers, wood industry occupations, printing industry occupations, welders, unskilled workers, road and railroad construction workers
Skilled manual	All manual occupations that showed at most 40 % unskilled workers in 1970	Glassblowers, bookbinders, typesetters, locksmiths, precision instrument makers,electrical mechanics, coopers, brewers
Technicians	All technically trained specialists	Machinery technicians, electrical technicians, construction technicians, mining technicians
Engineers	Highly trained specialists	Construction engineering, electrical engineers, production designers, chemical engineers, physicists, mathematicians
Unskilled services	All unskilled personal services	Cleaners, waiters, servers
Skilled Services	Essentially, order and security occupations, as well as skilled service occupations	Policemen, firemen, locomotive engineers, photographers, hairdressers
Semiprofessions	Service positions that are characterized by professional specialization	Nurses, educators, elementary schoolteachers, kindergarten teachers
Professions	All liberal professions and service positions that require a university degree	Dentists, doctors, pharmacists, judges, secondary education teachers, university professors
Unskilled commercial	Relatively unskilled office and commerce occupations	Postal occupations, shop assistants, typists
Skilled commercial	Occupations with medium and higher administrative and distributive functions	Credit and financial assistants, foreign trade assistants, data-processing operators, bookkeepers, goods traffic assistants
Managers	Occupations that control factors of production, as well as functionaries of organizations	Managers, business administration, deputies, ministers, social organization leaders

Source: Own illustration based on Blossfeld (1987).

Table 2.10: IV-FE results – Explaining native wages for different demographic groups

Regressor	**Males**	**Females**	**Young workers**
Share of foreigners	**0.801*****	**1.071*****	**1.015*****
	(0.009)	(0.016)	(0.017)
Education in years	0.013***	0.017***	0.022***
	(0.0002)	(0.0002)	(0.0002)
Labor market experience	0.047***	0.043***	0.082***
	(0.00005)	(0.00009)	(0.00002)
Labor market experience^2	-0.0006***	-0.0004***	-0.003***
	(0.000001)	(0.000002)	(0.00001)
Log(Population/size)	0.0007*	0.017***	-0.005***
	(0.0004)	(0.0008)	(0.0008)
Labor demand index	0.003***	0.002**	0.003***
	(0.0007)	(0.001)	(0.001)
Share of low skilled	-0.141***	-0.194***	-0.062***
	(0.004)	(0.006)	(0.007)
Share of high skilled	0.229***	0.059***	0.356***
	(0.004)	(0.008)	(0.009)
Share of young workers	0.135***	0.339***	0.096***
	(0.003)	(0.006)	(0.007)
Individual fixed effects	✓	✓	✓
Area fixed effects	✓	✓	✓
Time fixed effects	✓	✓	✓
R^2	0.496	0.361	0.434
Number of observations:	4,236,485	2,099,720	1,402,325

Note: Heteroskedasticity robust standard errors in parentheses.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

Table 2.11: IV-FE results – Explaining native wages of males in occupation groups

Explanatory variable:	share of foreigners				
Occupation	Total	EU	Non-EU	N	R^2
Agriculture	1.210***	0.745***	-0.480	36,032	0.278
	(0.134)	(0.140)	(0.734)		
Unskilled manual	0.634***	0.701***	0.249***	703,561	0.526
	(0.011)	(0.012)	(0.023)		
Skilled manual	0.932***	0.853***	0.763***	1,007,556	0.514
	(0.016)	(0.015)	(0.034)		
Technicians	1.442***	2.060***	-0.217	293,664	0.523
	(0.079)	(0.148)	(0.255)		
Engineers	3.341***	2.624***	1.410***	201,072	0.372
	(0.302)	(0.308)	(0.388)		
Unskilled services	0.533***	0.688***	0.210***	521,578	0.346
	(0.015)	(0.019)	(0.027)		
Skilled services	0.505***	1.202***	-0.055	53,629	0.501
	(0.063)	(0.104)	(0.137)		
Semiprofessions	1.384***	1.645***	2.940***	87,375	0.522
	(0.116)	(0.148)	(0.607)		
Professions	3.201***	2.619**	3.235***	49,251	0.128
	(0.627)	(1.068)	(0.863)		
Unskilled commercial	0.870***	1.159***	0.407***	152,705	0.448
	(0.072)	(0.110)	(0.147)		
Skilled commercial	1.299***	1.679***	0.993***	681,892	0.579
	(0.046)	(0.090)	(0.081)		
Managers	1.131***	0.398	1.933**	140.847	0.178
	(0.242)	(0.460)	(0.768)		

Note: Heteroskedasticity robust standard errors in parentheses.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

3 Task specialization of natives and immigration

3.1 Introduction

A possible explanation why most empirical studies find a small (positive) effect of immigration on native wages despite an increase in the supply of workers lies in the fact that immigrants complement natives (with an equivalent level of education) by specializing in different tasks (Peri and Sparber, 2009). A striking difference between native and foreign-born workers is that the second group is highly concentrated in occupations characterized by the use of manual and physical abilities much more intensively than communication and interactive skills. Sectors like agriculture, construction, and personal or household services basically attract a large number of immigrant workers. On the one hand, jobs dominated by immigrants include builders, sorters, maidens, cooks, and waiters. This means immigrants are over-represented in manual jobs. This may be due in part to their worse language skills, and in part to their larger tolerance for (lower disutility from) manual labor (Lewis, 2013). On the other hand, jobs like those of coordinators, supervisors, or salespersons are rarely performed by foreign-born workers due to a lack of qualification. In any case, since (low-educated) immigrants have a comparative advantage over natives in manual rather than communication-related tasks, their specialization in manual jobs is typical in most rich countries (D'Amuri and Peri, 2014). In contrast to foreigners, natives have a comparative advantage in occupations that need the use of interactive and communication skills.[17] Hence, natives tend to specialize in relatively more communication-intensive occupations. Consequently, immigration increases the relative wages of workers in communication-intensive tasks over manual ones, pushing natives to specialize further in communication-intensive tasks. As a result, immigration has a positive effect on the wages of natives on an average.

This chapter aims to evaluate whether native workers are induced to specialize in jobs that involve relatively intensive complex (analytical, communicative/interactive and cognitive) tasks in response to the increased competition with migrants in jobs with a higher content of simple (routine and non-routine manual) tasks. To investigate this matter, I followed the work by Peri and Sparber (2009) and considered their general equilibrium model where natives compete in regional labor market with similar skilled immigrants. To the best of my knowledge, this is the first study that applies a task-based approach in this way to Germany. An important addition of this analysis is that I distinguished immigrants into two groups: those from the EU and those from non-EU countries. As shown before, an important share of immigrants come from EU-countries. It is conceivable that

[17] This group of tasks can be considered as diverse and more sophisticated.

foreigners from EU countries are more integrated into the society — more precisely, into the local labor market than non-EU citizens, because they may know cultural specifics, social norms, and institutions of the host country. The data suggest that foreign nationals, particularly from non-EU countries, get on an average fewer jobs in Germany than natives. In 2014, the employment rate of non-EU citizens was, at 58 %, significantly lower than that of EU foreigners (76 %) and natives (79 %). Again, the assumption is that EU immigrants have a closer cultural proximity to natives. Under this rationale, immigrants from the EU should have less of a comparative advantage in relative manual tasks than immigrants from non-EU countries do, because they are endowed with more Germany-related knowledge. As a result, immigrants from the EU countries would be expected to induce a different impact on the complex-to-simple task ratio of natives than immigrants from non-EU countries do. Moreover, I assessed how the effects of immigration on the task specialization of natives vary across demographic groups (women and young workers). The reason for this extension is that the occupational distribution of native men and women differ significantly, and native women display shorter job tenures than their native male counterparts. Hence, they may have accumulated, on an average, less labor market-specific human capital than native men. This suggests that women are more flexible regarding a job change, because it may be less costly for them to relocate to another job than it is for native men. Additionally, the differences in educational attainment of employed native women and the greater presence of immigrants in occupations in which native women are more heavily concentrated may have favored higher responsiveness rates among them (Amuedo-Dorantes and De la Rica, 2011). We should also keep an eye on the group of young workers because they have greater occupational mobility compared to older workers (Peri and Sparber, 2009). Thus, they might be affected differently by immigration.

I found that both groups of immigrants push natives towards occupations that are relatively more complex-intensive tasks and less simple-intensive tasks, as commonly found in the literature. But the effect of immigrants from non-EU countries is insignificant. Indeed, EU foreigners seemed to have altered the task specialization and, hence, the occupational distribution of natives. However, the magnitude of the impact of immigration is about twice as great in Germany than in the US. I also identified that this effect varies across demographic groups, being higher among women and young workers. By using the share of foreign-born workers, I showed that the positive relationship between immigration and the relative task provision of natives is plausibly causal. This result may help explain the small impact of immigration on native wages and employment, because foreign workers do not appear to be perfect substitutes for equivalently skilled native workers.

The rest of this chapter is organized as follows. Section 3.2 presents an overview of the relevant literature. Section 3.3 outlines the theoretical model and its main implications.

Section 3.4 describes the data, and the construction of my task measure, and presents some stylized facts. Section 3.5 introduces the empirical specifications. In Section 3.6, I present the main empirical results of this study. In Section 3.7, I perform some sensitivity analysis by utilizing alternative specifications. The chapter is concluded in Section 3.8.

3.2 The task-based approach and related literature

In general, the literature finds that immigration has no appreciable effect on the average wages and employment rate of native-born workers. Ottaviano and Peri (2006) argued that this is not a surprising result because the effect of immigration depends on the degree of substitution between native and immigrant workers with similar observable characteristics. If native and immigrant workers within the same educational group possess skills that lead them to perform divergent tasks and, therefore, specialize in different occupations, it is reasonable to find minimal impact of immigration on the employment and wages of natives. In fact, natives and immigrants do not compete for the same jobs.

Compared to the previous literature, Peri and Sparber (2009) focused on workers with little educational attainment (i.e. those without a college education) in the US. An important hypothesis is that less-educated immigrants and natives are imperfect substitutes in the production process: the former have a comparative advantage in occupations requiring simple physical ("manual") tasks, mainly because of a limited language proficiency, a lack of specific human capital skills, and imperfect knowledge of the local labor markets; the latter have an advantage in occupations that demand the use of interactive and communication ("complex") tasks. The authors provided empirical evidence that less educated immigrants tend to specialize in professions that need physical activity while the natives respond to immigration by increasing their supply of complex tasks to avoid competition with immigrants. Moreover, they observed that in the US, migrants with the same formal qualification level specialize in occupations that demand cognitive and analytical abilities, whereas their native-born counterparts specialize in occupations that require interactive and communication skills. This sorting of migrants into different occupations and firms with heterogeneous requirements of skills makes them imperfect substitutes for natives and may mitigate an important fraction of the negative wage effect of immigration. To the best of my knowledge, only a few studies have explored these findings outside the US, because this extension of the traditional migration literature is quite new.

The study by Amuedo-Dorantes and De la Rica (2011) used data from Spain for the 2000–2008 period. The authors applied the empirical specification of Peri and Sparber (2009). Their paper focused on three important features. First, Spain experienced a large magnitude of immigrants. The authors showed that the impact of immigration on the relative task supply of natives is larger in Spain than in the US. Natives relocate to

jobs with a higher interactive or communication content in response to an increase in immigration.

Second, almost half of the immigrant stock has Spanish as its mother tongue. The rationale behind the task specialization of natives in interaction-intensive tasks in response to an increase in the share of foreign-born workers rests on their comparative advantage in communication (language) skills. If this is true, the impact of immigration on native task specialization patterns in Spain should be lower than the one found in the instances when most immigrants' mother tongue is not the host country's language. The magnitude of the immigration impact in a country with a large share of immigrants originating from Spanish-speaking countries suggests that proficiency in the host country's language is not the determining factor that drives the apparent impact of immigration on the task specialization of natives.

Finally, many women entered the Spanish labor market during the 1980s and 1990s, and they appear to be more highly educated than native men. In sum, native men and women may reveal different reaction patterns if the share of foreign-born workers increases. Indeed, the analysis reveals significant gender differences in the impact of immigration on the relative task supply of natives, possibly resting on the occupational concentration of immigrants and native occupational segregation patterns, by gender, among other factors. Specifically, an increase by one standard deviation in the share of foreign-born workers lowers the relative manual task supply of native men by 1.1–1.3 %. For native women, the figures range between 2.4 and 2.7 %.

D'Amuri and Peri (2014) analyzed the impact of immigration on the type and number of native jobs. They used the data of 15 western European countries during the 1996–2010 period, and explored its variation in the light of differences in the labor markets' institutional characteristics. Again, they established that the inflow of immigrants pushes natives to occupations with higher skill contents, and that relocation was stronger in countries with low levels of employment protection legislation. Moreover, in the short run, this job upgrade was associated with a 0.7 % increase in native monthly wages for a doubling of the immigrants' share in the total population. They also documented that the job relocation slowed down but did not come to a halt during the Great Recession.

Ortega and Verdugo (2014) found evidence supporting the task specialization of natives for the French labor market. First, they showed that the degree of similarity of the distribution of natives and immigrants within education or experience cells is negatively related to the share of immigrants in the cell. This result indicated that a large presence of immigrants within the cell encourages natives to perform more abstract tasks. In other words, natives move to tasks that complement the routine tasks performed by immigrants. Importantly, in contrast to the study by Peri and Sparber (2009), this relation holds for

all educational groups, both at the national and at the regional level. Second, a relocation of natives to better-paid occupations can be observed within the cells.

A previously mentioned research by Foged and Peri (2016) provided a causal effect of low-skilled immigrants on the labor market outcomes of natives. They used a panel of all residents of Denmark for 1991–2008, and exploited an exogenous dispersion of refugees across Danish municipalities and a later surge in immigrants to track how such an exogenous shock affected native workers. The authors analyzed how non-college-educated native workers responded to an increase in the number of refugees (from Yugoslavia, Somalia, Afghanistan, and Iraq). They found that especially for the native workers who moved across establishments, refugees spurred significant occupational mobility of low-educated natives, especially, the young or short-tenure ones, and increased specialization into complex jobs, using analytical and communication skills more intensively and manual skills less intensively. This upgrade to less manual-intensive and more complex jobs was accompanied by a significant wage increase. This result disproves classical labor market theories about native workers losing their jobs when immigrants take up low-paid jobs, because workers who have moved towards jobs that need more communication skills have led to a decreased competition for the low-paid jobs. The data also showed that the trend of immigration creating better-paid jobs for native workers in low-paid industries only applies to the private sector since there appears to be more flexibility in terms of restructuring the jobs in the private sector. At the same time, there is a greater staff turnover in companies than in the public sector in which the tasks are more fixed. Another observation to be emphasized is that people tend to move across jobs and firms — even industries. Certainly, the high job mobility, facilitated by the flexibility and competitiveness of the Danish labor market, was the key catalyst for the observed response of the native workers. The purpose of this study is to fill the gap in the evidence for Germany.

3.3 Theoretical framework and explanations

In this section, I will outline the main elements and predictions of the comparative advantages in the task performance model developed by Peri and Sparber (2009) and adapt it to the German context to have a reference for the empirical analysis.

In this general equilibrium model, it is assumed that an economy produces a tradable final consumption good (Y), which only needs a low-skill intermediate input(Y_L). For the sake of simplicity, the focus will be on low-skill goods because competition between natives and immigrants is more likely to occur in low-skill jobs. It is implicitly assumed that high-skill goods are produced, according to a linear technology, equal to the total supply of highly educated workers, that is, $Y_H = H$. On the contrary, the good Y_L is produced by

low-educated workers and needs a technology that combines two different types of tasks, simple/manual (M) and complex (C).[18] Simple tasks can be divided into two categories: routine manual and non-routine manual. Examples of manual tasks include the ones that require physical coordination and strength, such as carrying heavy objects, or using hands/tools in the workplace. According to Levy et al. (2003), non-routine tasks cannot be performed by computers. More generally, these tasks are characterized by non-repetitive work methods. The key feature of routine tasks is that they are easily replaceable by machines. As a consequence, workers who perform routine tasks show a higher elasticity of substitution towards capital than non-routine labor.

As the name suggests, complex tasks require multi-skilled workers, namely those with good analytical, cognitive, and communication abilities. An important analytical skill is being able to collect data and research a topic, whereas employees with strong communicative skills can explain the patterns they see in the data. Moreover, they can explain information orally in front of an audience, such as in a meeting or presentation. At other times, they have to be able to perform teamwork or supervise the work of others (Bisello, 2014). Thus, these workers need both strong written and oral communication skills. Last but not least, cognitive tasks require skills like making decisions and solving problems. The key conclusion of this model is that less educated natives and immigrants are assumed to differ in their efficiency in simple rather than complex tasks. More precisely, immigrants enjoy a comparative advantage in manual tasks over natives partly because of language difficulties and the lack of host-country-specific human capital (Amuedo-Dorantes and De la Rica, 2011). Finally, the good Y_L is produced according to the following Constant Elasticity of Substitution (CES) production function:

$$Y_L = \left[\beta_L M^{\frac{\theta_L - 1}{\theta_L}} + (1 - \beta_L) C^{\frac{\theta_L - 1}{\theta_L}}\right]^{\frac{\theta_L}{\theta_L - 1}} \tag{3.1}$$

where $\beta_L \in (0, 1)$ captures the relative productivity of simple skills and $\theta_L \in (0, \infty)$ measures the elasticity of substitution between M and C.

Profit maximization in a competitive market then yields the following relative demand function for complex versus simple tasks:

$$\frac{C}{M} = \left(\frac{1 - \beta_L}{\beta_L}\right)^{\theta_L} \left(\frac{\omega_C}{\omega_M}\right)^{-\theta_L} \tag{3.2}$$

[18] In contrast to the study by Peri and Sparber (2009), which focuses more on narrowly defined communicative tasks, the complex task category incorporates analytical, cognitive, and interactive/communicative tasks. The decisive reason for this approach is that D'Amuri and Peri (2014) provided empirical evidence that immigration pushes (both low and highly skilled) native workers towards occupations that are relatively more complex–intensive tasks (communication and abstract tasks).

in which ω_C is the relative compensation for complex versus simple tasks. This means that the relative task demand in equation (3.2) is directly related to the worker's relative efficiency in performing different tasks and the relative task compensation. The model assumes that less-educated natives and immigrants differ from each other in terms of relative task productivity. Each less-educated worker allocates one unit of time to perform μ_j units of simple tasks, ζ_j units of complex tasks, or the combination of the two. The assumption that natives have a comparative advantage in complex tasks implies that $(\zeta_N/\mu_N) > (\zeta_F/\mu_F)$, in which the subscripts N and F refer to natives and foreigners respectively. This term is intuitive due to the assumption that a larger fraction of immigrants decreases the average relative complex skills of the workforce. Similarly, a decrease in the relative complex ability of immigrants (ζ_F/μ_F) for a given share of employment would decrease the average relative complex ability of the workforce.

To find the equilibrium relative provision for complex versus simple tasks for natives and immigrants is derived from labor income maximization of a representative individual who allocates her/his time between the two types of tasks:[19]

$$\frac{c_j}{m_j} = \left(\frac{\omega_C}{\omega_M}\right)^{\frac{\delta}{1-\delta}} \left(\frac{\zeta_j}{\mu_j}\right)^{\frac{1}{1-\delta}} \tag{3.3}$$

in which $\delta \in (0,1)$ captures the decreasing returns from performing a single task. Equation (3.3) describes the individual relative task supply of complex versus simple tasks for natives (j=N) and immigrants (j=F). The relative supply depends positively on relative task compensation, ω_C/ω_M, and on the worker's relative efficiency in performing tasks, ζ_j/μ_j. However, given that natives are more efficient than immigrants in providing complex rather than simple tasks, it can account for different optimal provisions between immigrants and natives. To do so, the relative task supply C/M in this whole economy, obtained by aggregating individual task supply in (3.3), is a weighted average of the relative supply by natives and immigrants of both tasks:

$$\frac{C}{M} = \frac{C_F + C_N}{M_F + M_N} = \varphi(f)\frac{C_F}{M_F} + (1-\varphi(f))\frac{C_N}{M_N} \tag{3.4}$$

The weight $\varphi(f)$ represents the share of manual tasks provided by immigrants, which is simply a monotonic transformation of the foreign-born share of low-educated workers $f = L_F/L_F + L_N$. This weighting procedure allows one to account for different optimal task provisions between immigrants and natives. The equilibrium relative compensation of tasks ω_C^*/ω_M^* is then easily obtained by substituting (3.3) for the natives and immigrants in (3.4), and then, by equating the relative supply for the relative demand in (3.2):

[19] Some derivations are being skipped for simplicity. For a more detailed description of the model, see the original paper.

$$\frac{\omega_C^*}{\omega_M^*} = \left(\frac{1-\beta_L}{\beta_L} \right)^{\frac{(1-\delta)\theta_L}{(1-\delta)\theta_L+\delta}} \left[\frac{\zeta}{\mu} \left(\underset{(-)}{f}, \underset{(+)}{\frac{\zeta_F}{\mu_F}} \right) \right]^{\frac{-1}{(1-\delta)\theta_L+\delta}} \tag{3.5}$$

where the function $\frac{\zeta}{\mu}\left(f, \frac{\zeta_F}{\mu_F}\right)$ is the average relative complex ability. More precisely, $\frac{\zeta}{\mu}\left(f, \frac{\zeta_F}{\mu_F}\right) = \left[\varphi(f)(\zeta_F/\mu_F)^{\frac{1}{(1-\delta)}} + (1-\varphi(f))(\zeta_N/\mu_N)^{\frac{1}{(1-\delta)}}\right]^{(1-\delta)}$.

The expression for the optimal supply of complex to simple tasks by natives is derived by substituting the equilibrium wage into the aggregate task provision for natives:

$$\frac{C_N^*}{M_N^*} = \left(\frac{1-\beta_L}{\beta_L} \right)^{\frac{\delta\theta_L}{(1-\delta)\theta_L+\delta}} \left(\frac{\zeta_N}{\mu_N} \right)^{\frac{1}{(1-\delta)}} \left[\frac{\zeta}{\mu} \left(\underset{(-)}{f}, \underset{(+)}{\frac{\zeta_F}{\mu_F}} \right) \right]^{\frac{-1}{(1-\delta)\theta_L+\delta}\frac{\delta}{1-\delta}} \tag{3.6}$$

According to equation (3.6), an increase in the share of immigrants (f) has a negative effect on the average relative complex ability $\frac{\zeta}{\mu}\left(f, \frac{\zeta_F}{\mu_F}\right)$. This, in turn, leads to an increase in the return to complex tasks relative to the simple ones and, ultimately, a rise in the relative supply of complex tasks by natives. Hence, the hypothesis that can be empirically tested is that low-educated natives respond to immigration inflows by increasing their provision of complex tasks.

3.4 Measuring tasks and stylized facts

More recent literature has stressed the notion of linking tasks and activities workers perform on the job to the skills or specific knowledge needed to carry out these activities (Acemoglu and Autor, 2011; Haas et al., 2013; Autor, 2015). An asset of the "task-based approach" is that it offers a framework to classify jobs according to their core task requirements, and then, considers the set of formal and informal skills required to carry out these tasks. For example, Autor et al. (2006) pointed out that highly skilled workers perform different and more interactive (or communicative) tasks compared with low-skilled workers. To examine whether immigration induces natives to relocate to jobs that demand interactive or non-manual skills rather than manual abilities, I relied on the previous datasets that I have described in section 1.4. The final dataset was then merged into the task requirements from an additional source provided by Dengler et al. (2014). The construction of their task intensity measure was based on the BERUFENET expert database.[20] BERUFENET includes around 3,900 job titles used in Germany,

[20] For more information, visit the BERUFENET homepage provided by the German Federal Employment Agency: http://berufenet.arbeitsagentur.de/berufe/index.jsp.

for which a rich set of occupational information is provided (e.g., information on the required tasks in an occupational activity, the equipment used, the working conditions, the required qualifications or the legal regulations). These activities were pooled into five task categories, and each occupation had a value for each task category. The task categories with some examples are:[21]

1. Analytical tasks (developing, researching, investigating, and documenting)
2. Communicative tasks (teaching, marketing, selling, presenting, and negotiating)
3. Cognitive tasks (measuring, controlling, and quality checks)
4. Routine manual tasks (fabricating, stocking, controlling machines, and transporting)
5. Non-routine manual tasks (repairing, serving, healing, patching, and nursing)

To calculate the main task type and composition, only the core requirements listed for the occupations were used. The calculated shares of the five task types relating to the total number of requirements listed for this occupation are presented in the requirement matrix for each single occupation, with each requirement receiving a weight of 1.[22] The Dengler, Matthes, and Paulus (DMP) task index is defined as follows:

$$DMP_{ijt} = \frac{\text{Number of requirements in task type j in occupation in in year t}}{\text{Total number of requirements in occuaption i in year t}} \tag{3.7}$$

Thus, the DMP task index indicates the share of requirements in the single occupation i in the respective task type j (analytical [1], communicative [2], cognitive [3], routine manual [4], and non-routine manual [5]) for the year t (t=2011, 2012, 2013) in relation to the total number of requirements in the single occupation i for the year t.

The main task type, both for KldB 1988 (classification of occupations in 1988) and KldB 2010, at the 3-digit level is determined with the DMP task indices at the single occupational level being aggregated into the 3-digit level by employing a weight. The task type with the highest weighted DMP task index on the basis of the 3-digit code is the main task type for this code. For example, analytical tasks are the main tasks in the five task categories economists perform.[23] The weighted DMP task index (WDMP) can be measured as follows:

$$WDMP_{jkt} = \sum_{i \in k}^{K} DMP_{ijt} * g_{it} \tag{3.8}$$

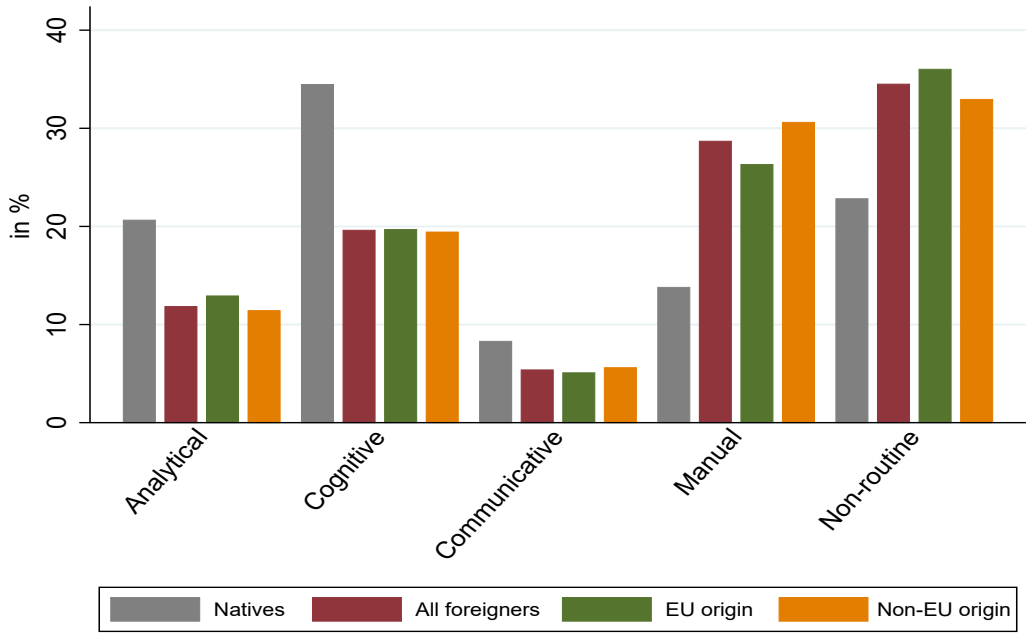
[21] For more details see Table 3.6 in the Appendix .
[22] See Table 3.7 in the Appendix.
[23] See Table 3.7 in the Appendix.

with the DMP task indices at the single occupational level i being aggregated to the 3-digit level (k) of KldB 1988 or KldB 2010 for each task type j in the year t with the weight (g) at the single occupational level i in the year t.

Table 3.7 in the Appendix displays the five task measures for some of the 3-digit-level occupations under consideration. As expected, high-skill occupations have a greater content of analytical or interactive tasks and a smaller content of manual tasks than low-skill occupations do. In contrast, low-skill occupations, like farming, road-building, or roofing, have, on an average, a greater content of manual (routine or non-routine) tasks as compared to communicative ones than high-skill occupations do. This classification of occupations makes the results easily comparable with previous studies for other countries.

I distinguished between two types of workers (natives and foreign-born) performing two broad types of tasks (complex and simple). The complex tasks incorporate analytical, communicative, and cognitive tasks, while the simple tasks comprise routine manual and non-routine manual tasks. Overall, the distribution of migrants and natives is unequal between the task categories. Immigrants perform, on an average, more simple tasks and fewer complex tasks than the native workers. The Figure 3.1 shows evidence of the concentration of immigrants in occupations with highly manual and non-routine but low-cognitive and communication content.

Figure 3.1: Distribution of workers across task categories, West Germany



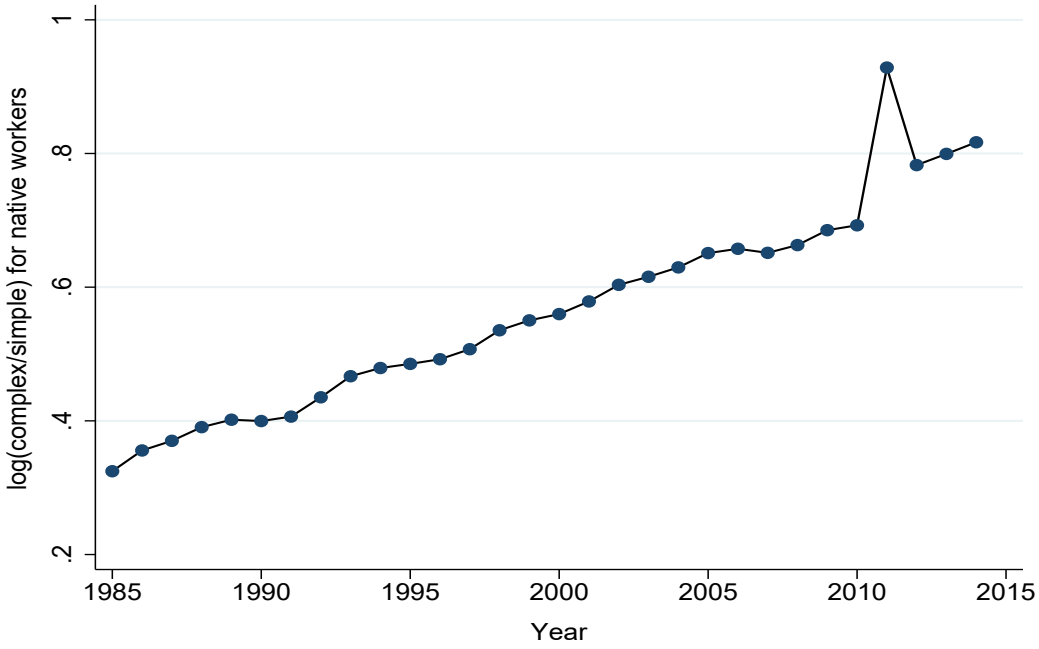
Source: Own illustration based on data from the IAB.

For example, the manual non-routine task category included about 35 % of the total number of immigrant workers during the observation period. Moreover, no major differ-

ences could be observed between the workers from the EU and non-EU countries. Natives are indeed over-represented both in cognitive and non-routine tasks. But it is striking that the share of native workers who perform manual tasks is less than half that of foreign workers.

Figure 3.2 provides more detailed information about the trend of different tasks performed by native workers. The vertical axis represents the logarithm of the relative supply of task intensity (complex/simple) of native workers, and the horizontal axis shows the time. This graph illustrates that the relative task supply of native workers who provide more complex tasks has increased over time. Moreover, a rapid increase — which looks like the reaction to a shock — of the relative supply of complex versus simple tasks can be observed for 2010. Natives shift the relative supply of tasks towards the tasks in which they hold a comparative advantage.

Figure 3.2: The relative task supply (complex/simple) of natives, 1985–2014

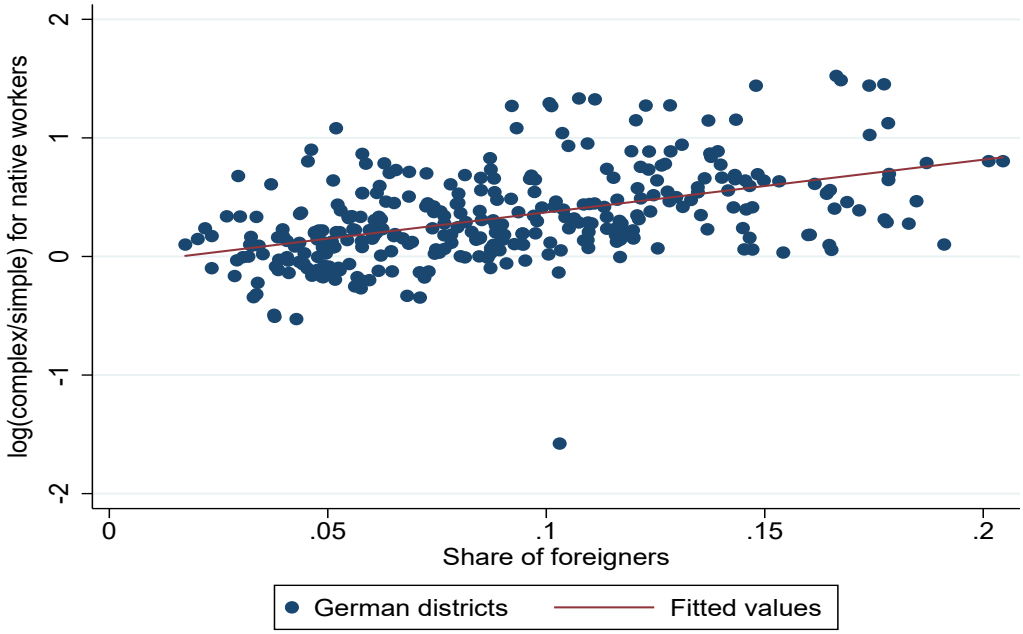


Source: Own illustration based on data from the IAB.

Figure 3.3 plots the constructed relative task supply (complex/simple) for natives against the share of immigrant workers for German districts and the overall 1990–2014 average. This figure shows a positive relationship between the two variables. Districts in which the foreign-born presence grew rapidly were also the ones in which natives (after controlling for demographic characteristics) shifted their supply more towards complex tasks and away from manual (simple) ones. For example, in 2014, there was a strong, positive correlation between the level of relative task supply among natives and the share of immigrants. These correlations constitute preliminary evidence supporting the prediction of the presented model that an inflow of (low-educated) immigrants pushes (low-educated)

natives to supply more complex skills relative to manual ones.

Figure 3.3: Share of foreigners and the relative task supply (complex/simple) of natives



Source: Own illustration based on data from the IAB.

3.5 Empirical implementation

I collapsed my data into district-time cells using data from 325 German districts (d) from 1990 to 2014 (t) to test the hypothesis, whether natives relocate to jobs characterized by a higher/complex to simple/manual task ratio (C/M) as the shares of foreign-born workers increase. By taking the logarithmic derivative of the optimal provision of complex to simple tasks in equation (3.6), one can empirically test the predictions of the model presented in section 3.3 using the following linear specification:

$$ln\left(\frac{C}{M}\right)_{dt} = Z'_{dt}\beta_1 + \beta_2 S_{dt} + \varphi_d + \delta_t + \varepsilon_{dt} \tag{3.9}$$

The vector δ_t represents year-fixed effects intended to account for common time-varying technological parameters (i.e. nation-wide shocks) captured by the term: $(\delta\theta_L/((1-\delta)\theta_L + \delta)) \times ln((1-\beta_L/\beta_L)$ from equation (3.6). The vector φ_d contains area (in my case, district) fixed effects that account for variations in unobserved population characteristics included in the following term from (3.6): $(1/(1-\delta)) \times ln(\zeta_N/\mu_N)$. In addition to accounting for time-variant district characteristics, I included the vector Z'_{dt}, which contains variables like population density or the share of highly skilled workers. This prevents the risk of potential spurious correlations between the immigration shock and the provision of

complex to simple tasks by natives. The regressor S_{dt} is the share of foreign-born workers measured as the ratio of immigrants to natives in each cell. Its parameter $\beta_2 \equiv -(1/((1-\delta)\theta_L+\delta))(\delta/1-\delta)) \times (\partial ln(\zeta/\mu)/\partial f)$ is the main coefficient of interest. If natives specialize in occupations that need more complex rather than simple tasks, in response to inflows of immigrants, the estimator for the parameter β_2 should be positive and statistically different from zero. In the next section, this hypothesis will be empirically tested. Finally, ε_{dt} in (3.9) is a non-correlated zero-mean disturbance term.

I also estimated whether the share of (low-educated) foreign workers is correlated with the logarithm of the number of native workers who perform either complex tasks (with analytical, cognitive, and communicative skills) or manual (simple) tasks. This is done by separately estimating the following equations (3.10) and (3.11)

$$ln(C)_{dt} = Z'_{dt}\beta_1 + \beta_c S_{dt} + \varphi_d + \delta_t + \varepsilon_{dt} \tag{3.10}$$

$$ln(M)_{dt} = Z'_{dt}\beta_1 + \beta_s S_{dt} + \varphi_d + \delta_t + \varepsilon_{dt} \tag{3.11}$$

in which β_c and β_s are the coefficients for the share of foreigners in district d and year t on the complex and simple task supply of natives, respectively.

Finally, I estimated a linear probability model on whether native workers move from simple to complex tasks in response to immigration. To examine this relationship, I ran the following regression:

$$Dtask^{NAT}_{idt} = X'_{it}\beta_1 + Z'_{dt}\beta_2 + \beta_3 S_{dt} + \gamma_i + \varphi_{area} + \delta_t + \varepsilon_{idt} \tag{3.12}$$

in which the discrete dependent variable $Dtask^{NAT}_{idt}$ takes the value of 1 if the individual i in district d at time t performs complex tasks and the value of 0 if s/he performs simple tasks. The control variables are the same ones I have used for equation (2.17). Our explanatory variable of interest is still S_{dt}. This specification allows an investigation into the individual instead of the district level. To the best of my knowledge, this analysis is the first attempt to apply such a kind of model in this research field. Again, I used the shift-share instrument, which has been described extensively in section 2.6, to address any potential endogeneity between the (relative) provision of tasks by natives and the supply shock due to immigration. Finally, it is worth noting that the case of reverse causality should be less of a problem here with task specialization than with wages or employment. The reason is that immigrants are unlikely to choose to settle in areas due to the particular task specialization of natives.

3.6 Empirical results

In this section, I use the empirical specifications given by equations (3.9) to (3.12) to test whether immigration induces (less-skilled) natives to specialize in more complex and demanding tasks. At first, the focus refers to the correlation between the foreign-born share of low-educated workers and the relative supply of tasks by native workers across German districts. The assumption is that low-educated immigrants are more similar to the natives who perform simple/manual tasks. The OLS-estimate in column 2 of Table 3.1 suggests that a 1 percentage-point increase in the share of low-educated foreign-born workers is associated with a 0.624 % increase in the relative supply of complex versus simple tasks among natives.

Table 3.1: The impact of the share of low-educated foreign workers on the relative tasks supply of natives

Regressor	**OLS**	**FE**	**IV-FE**
Share of low-educated foreigners	**0.624*****	**0.871*****	**0.601*****
	(0.079)	(0.069)	(0.127)
Log(population/size)	0.131***	0.033	0.131***
	(0.011)	(0.111)	(0.011)
Labor demand index	-0.074	-0.014	-0.074
	(0.054)	(0.014)	(0.053)
Share of high skilled	4.666***	2.756***	4.683***
	(0.251)	(0.145)	(0.261)
Share of young workers	0.101	0.381***	0.104
	(0.108)	(0.075)	(0.110)
District fixed effects		✓	✓
Time fixed effects		✓	✓
R^2	0.753	0.678	0.754
N	8,125	8,125	8,125

Note: Heteroskedasticity robust standard errors in parentheses.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

The similarity of the coefficients in all three econometric methods of Table 3.1, and the fact that the point estimate is slightly smaller in the 2SLS regression (indicating a slight upward bias in the OLS-specification), strengthens the conviction that the immigration shock was largely an exogenous shift in the relative supply of skills at the district level to which the native workers responded. 2SLS estimates of the coefficient β_2 from equation (3.9) in Peri and Sparber (2009) range from 0.37 to 0.51, making my coefficient comparable

to the one estimated in the US, even if there is a small difference with regard to the definition of our dependent variable. Note that my broader measure of complex tasks was closely related to language proficiency; the measures of interactive skills also refer to cognitive, analytical, and vocal task requirements, which may not be present in immigrants (Amuedo-Dorantes and De la Rica, 2011).

The (unreported) first-stage F-test shows that my instrumental variable strongly explains the endogenous regressor S_{dt}. For example, for the entire sample of natives, the F-statistic is 740.08 with a p-value=0.000.[24] Moreover, the included control variables, like population density or the share of highly educated workers, have a positive significant effect on the task specialization of natives. This result is intuitive because districts with a higher population density are likely to experience increased task specialization in industries suited to urban environments, such as the financial services sector in Frankfurt. If there are spillover effects from greater accumulated human capital, these externalities suggest that living in an area with more educated people may have positive net effects on the group of low-skilled inhabitants. A highly skilled worker may increase the productivity of co-workers, because of knowledge spillovers and the generation of new ideas (Glaeser and Resseger, 2010). Additionally, imperfect substitutability in production between different types of workers causes increases in the local proportion of highly skilled workers to affect the supply of low-skilled workers in the area. In other words, human capital spillovers can trigger skill upgrade for workers with a low education level. This, in turn, may promote workers to move from routine-based tasks toward abstract-intensive tasks.

Literature suggests a significant degree of occupational segregation by gender, which also characterizes the German economy. There are some reasons for this phenomenon: women often interrupt their career (e.g. on grounds of pregnancy); they exhibit a lower participation rate in the overall labor force, which can be attributed to their comparative advantage in home production, and lower investment in human capital (Seifert and Schlenker, 2014). Women are also more likely to work part-time than men in most occupations. As a result, women display shorter job tenures than their native male counterparts, and may accumulate less occupation-specific human capital than native men. Therefore, they are overrepresented in low-productivity occupational groups like unskilled commercial (in my data set, the share of female employees was about 65 % in 2014), unskilled services or unskilled manual. As indicated in Figure 2.3, the share of foreigners is particularly high in these occupational groups. From this, it could be derived that it is less costly for native women to move to higher-paying occupations than for native men (Amuedo-Dorantes and De la Rica, 2011).

[24] Similar results are obtained for other specifications or sub-samples and are available from the author.

Another important demographic group is that of young workers because they have greater occupational mobility (older workers have very low rates of occupational change), and workers with extremely low educational attainment are potentially more threatened by immigrants (Peri and Sparber, 2009). The unequal distribution of women and young workers along occupations contributes to gender and age differences in task categories. If the presence of native young workers and women differ significantly in task categories, one would expect an increase in the share of immigrants to influence these two groups differently. IV estimates in Table 3.2 suggest that women and young workers (i.e. those below 31) respond to a percentage point increase in the low-educated foreign-born share by increasing their relative supply of complex versus manual tasks by 1.177 and 1.341 % respectively. This means the effect on women's and young workers' task specialization is substantially higher and statistically significant. In line with Peri and Sparber (2009) and Amuedo-Dorantes and De la Rica, 2011, these findings confirm the intuition that the impact of immigration is slightly higher on young natives because of greater occupational mobility, and on women because they are more vulnerable to job competition.

Table 3.2: IV-FE results for the impact of foreign-born workers on low-educated natives' relative task performance by demographic groups

Regressor	**Females**	**Young workers**
Share of low-educated foreigners	**1.177*****	**1.341*****
	(0.094)	(0.105)
District fixed effects	✓	✓
Time fixed effects	✓	✓
R^2	0.498	0.510
N	8,125	8,125

Note: Heteroskedasticity robust standard errors in parentheses.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

Table 3.3 shows what happens when foreigners are divided into two groups, namely EU and non-EU foreigners. Indeed, immigrants from EU countries push natives toward occupations with a higher ratio of complex/simple tasks, meaning that they have a comparative disadvantage in performing complex tasks, and they perform relatively more simple tasks. This result confirms, once again, that particularly young workers tend to specialize more in complex jobs in response to immigration inflows to German districts. Regarding the immigrant workers outside the EU, their overall impact leads natives to

update their jobs to occupations with a higher ratio of complex/simple task. But the extent of this effect is lower and the estimates are insignificant compared with those in the previous group. Thus, immigrants are complements to natives rather than perfect substitutes. Moreover, the significant positive impact of immigration from the EU countries on native task specialization in Germany casts serious doubts because this impact of immigrants relies, primarily, on cultural differences. In fact, the opposite is the case. Note, however, that this finding does not contradict the hypothesized importance of host-country-specific skills when it comes to explaining task specialization, as argued by Peri and Sparber (2009). Indeed, as shown in Table 3.3, cultural proximity may be one of the most important factors that drive natives' specialization from manual to complex tasks. Yet, the results suggest that host-country-specific skills are the sole factor driving the impact that immigration appears to have had on the task specialization of natives.

Table 3.3: IV-FE results for the impact of low educated foreign-born workers on natives' relative task performance by demographic groups

Regressor	**All workers**	**Females**	**Young workers**
EU foreigners	**1.777*****	**1.313****	**2.587*****
	(0.292)	(0.369)	(0.436)
Non-EU foreigners	**0.328**	**0.229**	**0.656**
	(0.305)	(0.476)	(0.482)
District fixed effects	✓	✓	✓
Time fixed effects	✓	✓	✓
R^2	0.742	0.490	0.510
N	8,125	8,125	8,125

Note: Heteroskedasticity robust standard errors in parentheses.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

I also investigated whether this positive effect is mostly related to an increase in the provision of complex skills or a decrease in the native's supply of manual tasks. This was done by separately estimating equations (3.10) and (3.11). According to Table 3.4, the IV-FE estimates of β_c and β_s suggest that one percentage-point increase in the foreign-born share is associated with a significant 0.514 % rise in natives' supply of complex tasks, and a decline of 0.574 % in the manual task supply. The magnitude or the sign of my coefficient β_c is similar to the finding for the US. The estimate of β_c reported in Peri and

Sparber (2009) is 0.31.[25]

Table 3.4: The impact of foreign workers on natives' task performance

Explanatory variable:	share of low-educated foreign-born workers		
Dependent Variable	IV-FE	R^2	N
ln(C)	0.514*** (0.049)	0.320	8,125
ln(S)	-0.574*** (0.051)	0.695	8,125

Note: Heteroskedasticity robust standard errors in parentheses. Both regressions include district and year fixed effects. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

Table Table 3.5 presents the results of the linear probability model. The result shows that after controlling for individual characteristics and the conditions of the labor markets in which the individuals make their choices, the share of less-educated immigrants has a significant effect on the native transition from simple to complex jobs. The IV-FE estimate for the variable S_{dt} implies that, everything else being fixed, an increase in the share of less-educated foreigners by one percentage point increases the probability that the native labor force moves from simple-tasks-based occupations toward complex ones by 0.095 or 9.5 percentage points.[26] Unfortunately, my results cannot be compared with those from previous studies, because this model has been applied in this research area for the first time. Note that the coefficients have the expected sign, confirming the findings presented in the previous section. For example, the coefficient on education in years means that another year of education increases the probability of changing the provided task by 0.020 or 2 percentage points. If we take this equation literally, 10 more years of education increases the probability of being in an occupation with complex tasks by 0.020 * 10 = 0.20 or 20 percentage points, which is quite an acceptable value in a probability. Furthermore, it is likely that natives respond to an increasing proportion of highly skilled workers by shifting their task supply and providing more complex rather than manual tasks. This occurs because more human capital in the districts can lead to more learning (Glaeser, 1999). This, in turn, can encourage workers to move to more demanding jobs.

[25] The estimate for β_s is -0.03.

[26] Using probit instead of a linear probability model does not change the results qualitatively. These results are available upon request.

Interestingly, there is a significant cross-effect between task specialization and district size in the context of population growth. District density spreads due to knowledge of proximity, which either makes workers more skilled or firms more productive (Glaeser and Resseger, 2010).

Table 3.5: The effect of low-educated foreign workers on the probability of changing the task category for domestic workers

Regressor	**OLS**	**FE**	**IV-FE**
Share of low-educated foreigners	**0.125*****	**0.181*****	**0.095*****
	(0.006)	(0.004)	(0.004)
Education in years	0.075***	0.020***	0.020***
	(0.0002)	(0.0003)	(0.0001)
Labor market experience	0.0004***	0.004***	0.003***
	(0.0001)	(0.0001)	(0.00005)
Log(population/size)	0.037***	0.002**	0.051***
	(0.0006)	(0.001)	(0.0004)
Labor demand index	-0.015***	-0.002**	-0.002***
	(0.002)	(0.0008)	(0.0007)
Share of high skilled	0.507***	0.086***	0.101***
	(0.011)	(0.010)	(0.004)
Share of young workers	0.074***	0.091***	0.078***
	(0.009)	(0.007)	(0.003)
Individual fixed effects		✓	✓
Area fixed effects		✓	✓
Time fixed effects		✓	✓
R^2	0.126	0.099	0.106
N	6,336,205	6,336,205	6,336,205

Note: Heteroskedasticity robust standard errors in parentheses.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

3.7 Robustness checks

I now take a closer look at the impacts of immigration on natives' relative task supplies by separately focusing on the total share of immigrants and two demographic groups. Table 3.8 (see in the Appendix) shows the pattern for the relative task supply of natives when we consider the total share of foreigners instead of the share of low-educated for-

eigners . For all regressions, the coefficient for the share of foreigners has become larger. Specifically, a 1 percentage point increase in the share of immigrants raises the relatively complex tasks by 1.033 to 1.380 %. Overall, natives perform more abstract than routine tasks in the districts with the higher number of immigrants. Amuedo-Dorantes and De la Rica (2011) also found a similar result. If they took into consideration the endogeneity of the variable share of foreigners, a one-standard-deviation increase in the share of foreign-born workers lowered the relative manual task supply of native workers by 1.5 to 1.7 %, depending on the relative task measure used.

Like Peri and Sparber (2009), I used a similar analysis with women and young workers to assess whether there are any significant differences between the responses to immigration of the natives in the US and Germany. Table 3.9 (see in the Appendix) displays the estimates from separate regressions for the two specific groups. The IV-FE estimates suggest that women respond to a percentage point increase in the foreign-born share by increasing their relative supply of complex versus simple tasks by 0.884 %. In accordance with the results obtained by Peri and Sparber (2009), the impact of foreign-born workers on the natives' relative task performance varies. It is, again, higher among young workers. I ran one more robustness test to check whether the baseline results are driven by the considered period and whether the results change substantially with alternative estimation samples. I focused on the period from 2010 to 2014 because, as shown in Figure 3.2, the relative task supply of natives has deviated from the long-term trend between these years. The result summary of the estimations, reported in Table 3.10, in the Appendix shows that all the coefficients remain similar to those obtained with the full sample. This finding suggests that the baseline results are not driven by the choice of the specific period of the sample.

3.8 Conclusion

Previous immigration studies have long discussed a puzzling result, that is, the fact that immigration appears to have no discernible effects on natives' wages and employment opportunities. Yet, if native and immigrant workers of similar observable characteristics lead them to specialize in different occupations, it is not surprising to find very small or no impact of immigration on the labor market outcomes of natives. A reason for this result is that immigrants and native workers generally do not compete for the same jobs. In this study, I assessed the impact of immigration on the German local labor markets from a task-based approach. Using occupational task-intensity and individual data provided by the IAB for 325 districts between 1990 and 2014, I empirically tested the predictions of the model of comparative advantage in task performance developed by Peri and Sparber (2009). The aim is to evaluate whether natives respond to increasing immigration inflows by shifting their provision of tasks from manual to more complex

(analytical, communicative, and cognitive).

Initially, I presented descriptive evidence that due to their comparative disadvantage in language skills, immigrants relative to natives specialize in occupations that are comparatively less complex and, thus, have a higher content of manual-physical (simple) tasks. This pattern suggests that foreign-born workers are not perfect substitutes for similarly educated native workers. I then extend the analysis to estimate the impact of immigration on the relative task supply (complex/simple) of German natives. To cope with the potential endogeneity of the share of immigrants, I constructed, with the help of the shift-share methodology, a suitable instrumental variable based on past immigration concentrations in German districts.

Hence, immigration has the following effect: an increase in the foreign-born share has a significant positive effect on the natives' relatively complex task supply. The IV-FE estimate suggests that a 1 percentage-point increase in the foreign-born share of low-educated workers is associated with a 0.601 % increase in the relative supply of complex versus manual tasks among natives. Actually, the magnitude of the estimator is about twice that of the estimated impact of immigration on the relocation of natives in the US. In other words, immigration leads German natives to specialize in more complex tasks in which they have a comparative advantage over immigrants. Importantly, and unlike previous work such as Peri and Sparber (2009), this relation holds without restricting the analysis to low-skilled foreigners, i.e. this also applies to the total share of foreigners.

I also showed that the correlation between immigration and the task specialization of natives varies across demographic groups. It is higher among women and young workers. For native women, the figures range between 0.884 and 1.313 %. Perhaps due to their different educational attainment, shorter job tenures, and occupational distribution, native women may enjoy higher job mobility, lower job relocation costs, and more vigorous competition from foreign-born workers. All these factors can cause greater job relocation on the part of native women, induced by immigrants. Young workers seem to indicate a greater shift of their relative task supply (the estimates lies between 1.341 and 2.587) in response to immigration. This result is reasonable since job-to-job mobility is more pronounced among young workers due to the desire to find the ideal workplace or employer (Fitzenberger and Kunze, 2005).

Since immigrants from the EU and non-EU countries are more or less evenly distributed in my sample (the proportion is 53 to 47 %), I explored the role of the home country in explaining native specialization patterns. Compared to the former studies, I separated immigrants into two groups: those having a cultural and geographical proximity (EU foreigners) to the host country and those having a different culture (non-EU foreigners). I found that both groups encourage natives to move to tasks that complement the routine

simple tasks performed by immigrants. However, immigrants from the EU countries have a stronger effect on the relative task supply of natives.

Overall, my findings have important labor market implications. First, they may help explain why previous economic analyses found only modest wage and employment consequences of immigration for the (low-educated) native-born workers. Second, immigration may, via adjustments in the natives' task specialization and occupational upgrade, help raise the job mobility of natives. This could positively contribute to labor market efficiency in the context of improved average job match quality (Amuedo-Dorantes and De la Rica, 2011). Enhanced job mobility is particularly important in a country like Germany for two reasons: on the one hand, Germany has a relatively rigid labor market, and on the other, job mobility, especially among workers with indefinite-term work contracts (the share of fixed-term contracts was, according to the German Federal Statistical Office (2017b), 35.3 % in 2015)[27], is highly constrained. Third, unlike traditional literature, it is important to treat women and men as heterogeneous groups when it comes to studying the effects of immigration on the task specialization of natives. Finally, my findings indicate that the foreigner's country of origin is an important factor that explains the impact of immigration on the task specialization of natives.

[27] In the same year, 37.1 % women and 33.1 % men were employed on a fixed-term contract.

3.9 Appendix

Table 3.6: Assignment of activities to the task classification scheme

Task type	**Requirements**
Analytical tasks (1)	Management, planning, planning and supervision, fields of competencies, economy, leadership, direction, controlling, sciences, software development, programming languages, network certifications, monitoring, music, singing, ballet, musical instruments, optics, applying laws, design, design (art), analysis, control, therapy, programming
Communicative tasks (2)	Commerce, counseling, service, support, training, marketing, advertising
Cognitive tasks (3)	Technology, metrics, administration, graphics, network technology, network protocols, operating systems, certificates, languages, knowledge of goods and products, competencies, sensor technology, electronics, mechanics, mechatronics, hydraulics, processing, revision, test, inspection, measurement, monitoring, procedures, diagnostics
Manual routine tasks (4)	Cultivation, farming, construction, manufacture, production, harvesting, operating machines, setting up machines, typesetting
Manual non-routine tasks (5)	Dancing, service, therapy (manual focus), special/custom/bespoke productions, refurbishing, handicraft businesses (e.g., bakery, carpentry)

Source: Own illustration based on Dengler et al. (2014).

Table 3.7: Tasks intensity of some 3-digit code occupations

Occupation	Analytical	Communicative	Cognitive	Routine	Non-routine
Architects	0.8381	0.0083	0.1297	0.0000	0.0238
Auditors, tax consultants	0.2527	0.0142	0.7301	0.0000	0.0000
Bookbinders	0.0185	0.0011	0.0055	0.9197	0.0551
Brewers	0.0787	0.0000	0.0787	0.8426	0.0000
Careers advisers	0.3100	0.6900	0.0000	0.0000	0.0000
Cashiers	0.0104	0.1947	0.7949	0.0000	0.0000
Dentists	0.5600	0.1800	0.040	0.050	0.1800
Deputies, ministers	1.0000	0.0000	0.0000	0.0000	0.0000
Economists	0.5900	0.0800	0.3200	0.0000	0.0000
Farmers	0.4119	0.0000	0.0060	0.5709	0.0112
Hairdressers	0.0200	0.1100	0.0100	0.0000	0.8500
Interpreters	0.0000	0.9800	0.0200	0.0000	0.0000
Keyboarders	0.0000	0.0000	1.0000	0.0000	0.0000
Laboratory chemists	0.1477	0.0000	0.8523	0.0000	0.0000
Leather producers	0.0000	0.0000	0.0000	1.0000	0.0000
Pastors	0.3300	0.5500	0.1200	0.000	0.0000
Polisher	0.0000	0.0000	0.0000	0.7000	0.3000
Radio operators	0.0000	0.0000	1.0000	0.0000	0.0000
Road builders	0.0223	0.0000	0.0147	0.0000	0.9630
Roofers	0.0147	0.0000	0.0768	0.0165	0.8920
Sellers	0.1511	0.3863	0.3184	0.0541	0.0901
Social pedagogues	0.3200	0.5400	0.0900	0.0000	0.0500
Teachers	0.6100	0.2300	0.1400	0.0000	0.0200
Vehicle drivers	0.0000	0.0000	0.0000	0.0000	1.0000
Winemakers	0.2264	0.0000	0.1260	0.2170	0.5440

Source: Own illustration based on Dengler et al. (2014).

Table 3.8: The impact of the share of foreigners on the relative task supply of natives

Regressor	**OLS**	**FE**	**IV-FE**
Share of foreigners	**1.033*****	**1.203*****	**1.380*****
	(0.230)	(0.232)	(0.296)
Log(population/size)	0.135***	0.062	0.132***
	(0.011)	(0.113)	(0.011)
Labor demand index	-0.073	-0.017	-0.075
	(0.055)	(0.014)	(0.054)
Share of high skilled	4.823***	2.722***	4.724***
	(0.224)	(0.154)	(0.264)
Share of young workers	0.155	0.452***	0.152
	(0.111)	(0.074)	(0.111)
District fixed effects		✓	✓
Time fixed effects		✓	✓
R^2	0.741	0.718	0.739
N:	8,125	8,125	8,125

Note: Heteroskedasticity robust standard errors in parentheses.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

Table 3.9: IV-FE results for the impact of foreign-born workers on natives'relative task performance by demographic groups

Regressor	**Females**	**Young workers**
Share of foreigners	**0.884*****	**1.821*****
	(0.313)	(0.342)
R^2	0.490	0.506
N:	8,125	8,125

Note: Heteroskedasticity robust standard errors in parentheses.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

Table 3.10: The impact of foreign workers on the natives' relative task performance for the 2010-2014 period

Regressor	IV-FE	R^2	N
Share of foreigners	1.031***	0.671	1,630
	(0.312)		
Share of low-educated foreigners	0.488***	0.693	1,630
	(0.147)		
EU foreigners	1.857**	0.695	1,630
	(0.918)		
Non-EU foreigners	0.308	0.671	1,630
	(0.866)		

Note: Heteroskedasticity robust standard errors in parentheses. All regressions include district and year fixed effects. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on data from the IAB.

4 Housing market and immigration

4.1 Introduction

Because of globally increasing migration flows, the economic impact of cultural diversity has attracted the attention of many researchers in recent years. The notable difference between the current and earlier migration flows is that migrants have become more diverse, both in terms of motives (e.g. job, family, education, etc.) and characteristics (e.g. nationality, age, profession, etc.). This variety in migrants leads to cultural pluralism, especially in agglomerated areas. According to the 2013 census, the proportion of foreigners in German metropolitan regions like Stuttgart was 22.8 %, compared with 25.4 % in Munich. In the same year, people with Greek roots accounted for 6 % of the entire foreign population of Munich, and they were the second largest ethnic minority group after Turkish citizens (11 %).

Cultural, or more precisely, linguistic similarity is also an important factor that influences an immigrant's settlement choice as to where to reside in the target country, because effective communication is fundamental for everyday life. For the immigrants who do not share a common language with natives, communication is a barrier. As a consequence, the demand for immigrant-specific amenities like foreign schools for kids, and medical and financial services are important for them. Instead, for immigrants with a common culture, the demand for the same services and amenities is lower. They can use services that are oriented towards the native population. Hence, for the common-culture immigrants, the demand for culture-oriented services should not be location-specific. They can also integrate themselves in social networks shared by natives. Thus, migration flows to destinations with a large number of ethnic and linguistic enclaves are clearly larger.

With an ongoing demographic change in many countries, it is no wonder that immigration is of great importance. So far, economists have focused on wage impacts, and have found either no or small effects. But immigrants also consume amenities and housing services in the areas where they settle. Therefore, the effects of immigration are reflected in the changes in housing prices and rents, which, in turn, affect real wages and wealth (Grossmann et al., 2013). The magnitude of this impact depends on the reaction of the supply of housing to the increased demand due to immigration. Contrary to the labor demand, the supply of housing is primarily inelastic, at least in the short run. This striking feature of the housing market causes the adjustment process to be much slower for rental prices than for wages. What is largely overlooked is that housing and property owners benefit immensely from immigration. In this study, I argue for the high economic importance of the housing market. Germany is one of the most popular immigration countries, but to the best of my knowledge, information about the effect of cultural diversity and

cultural similarity on the housing market in this country is lacking. The present work aims to fill this gap.

There are two views as to why migrants provide complex contributions to the economy of the destination country. First, cultural diversity can generate costs from potential conflicts of preferences, communication hurdles, or outright racism, prejudice, or fear of other groups, leading to a sub-optimal provision of private and public goods (Alesina and Easterly, 1999; Alesina, 2004). This is only one side of the coin. Second, diversity can also help natives to learn other ways of life and what goes on in other places in the world. It brings variety to almost every part of our ways of life. Diversity helps people better appreciate humanity and human rights in general. Diversity of cultures can be regarded as an enriching opportunity if constitutional rules of free, democratic, and tolerant society are not infringed upon. Moreover, cultural diversity creates potential benefits by increasing the variety of goods, services, and skills available for consumption and production (O'Reilly III et al., 1998; Lazear, 1999a,b). One part of the migration literature even assumes that by bringing together complementary skills, different abilities, and alternative approaches to problem-solving, diversity may boost creativity, innovation, and ultimately, growth. More precisely, workers from different backgrounds can generate a positive externality on one another, increasing productivity at the plant level (Florida, 2002a,b; Berliant and Fujita, 2008). Nevertheless, findings about the urban or regional effects of immigration are controversial. On the one hand, some see great value and benefit in increased cultural diversity (Ottaviano and Peri, 2006). On the other, others fear that increased immigrant presence comes only at the expense of the native-born (Borjas, 1994). More research is required to understand the mechanism behind the impact of immigration on economic outcomes.

The chapter's objective is to show empirically that the strength of the spatial correlations between the housing market and immigration is explained by the immigrant's culture. There are some reasons why examining the impact of immigration in the German context is desirable and useful. First, the composition of foreigners is significantly different in Germany than in other regions. Mexico and Central America, for example, account for a large share of immigrants in the US. Germany's immigrants tend to come from a wider spectrum of countries (most of the migrants living here are from Turkey, Poland, Italy, or Romania). Immigrants from different countries bring a distinct set of values and skills which play a role in the overall diversity effect. For example, Fischer (2012) examined the behavior of Swiss house prices to European immigration flows for 85 districts between 2001 and 2006, and showed that an immigration inflow from non-common-language countries equal to 1 % of an area's population coincides with an increase in prices for single-family homes by about 4.9 %. However, immigrant influx from a common-language country has no impact. Second, undocumented immigration is less of a concern in Germany because

the presence of many illegal migrants leads to higher rents in the area due to the increase in housing demand. Neglecting this fact can distort the results of the empirical analysis. Finally, a comparison of the results between Germany and other countries can help us better understand the role of institutional framework and governmental policy in determining diversity effects. An effective migration policy is in the interests of society, since immigration is a subject that affects many fields of the economy.

I used annual data on the stock of foreigners, housing rents, and prices at the district and autonomous city level in Germany, and found a very robust impact of cultural diversity on rents and housing prices which is bigger in magnitude than the estimates of the wage literature. My main findings from this study are threefold. On the one hand, cultural diversity enhances regional or urban attractiveness, thus confirming previous research. An increase in the diversity index by 0.1 is associated with increases in the average housing rents and prices between 11 and 15 %. In accordance with previous studies, the effect of diversity appears to be more pronounced in urban than rural areas. On the other hand, greater language similarity within an area has a stronger positive impact on regional or urban attractiveness. In other words, even though culturally diverse areas are very attractive to potential migrants, this advantage is exacerbated if there is a substantially large language similarity between natives and immigrants in the area. This implication is, to my knowledge, a new contribution to the understanding of how immigration affects economic outcomes. But, contrary to these findings, if the share of foreigners is considered as a whole group, the impact on rents is negative. I estimated that an increase in the share of foreign-born people by 1 % decreases housing rents per square meter by about 1 % in all cities. This evidence is also accompanied by the fact that an immigrant shock to a district induces natives to resettle in other areas. The mechanism underlying this phenomenon can be explained by an income effect (i.e. the displacement of natives due to the increased demand for housing by immigrants) and an amenity effect. The results are very important in understanding the local economic impact of immigration and the link between immigration and the residential location decisions of natives.

The rest of the chapter is structured as follows: Section 4.2 contains a review of the previous literature. Section 4.3 briefly introduces the theoretical model that is used to develop a consistent estimation procedure for the diversity effect on the mean rents. Section 4.4 discusses the measured indices for cultural diversity and linguistic similarity. Section 4.5 describes the data sources, key summary statistics, and stylized facts about cultural diversity in Germany. In Section 4.6, I present the empirical strategies adopted to test the theoretical findings. The results of the empirical analysis are shown in Section 4.7. Finally, Section 4.8 reports the results from various robustness checks. A conclusion of my findings is summarized in Section 4.9, along with a discussion of the limitations of this study and the directions for future research.

4.2 Previous empirical literature

This study is related to a number of recent papers that have analyzed the relationship between immigration and local economies. Work in this area was pioneered by Saiz (2003). This study analyzed the impact of the 1980 Mariel Boatlift on the Miami housing market. The main finding was that rents in Miami increased as a result of the demand shock between 1979 and 1981 from 8 to 11 % more than the comparable housing markets during this time. Immigration was the most likely explanation for this differential growth in rent. Another important conclusion of the author was that immigrants generally cause a short-term increase in rental prices. Namely, an immigrant inflow equal to 1 % of a city's population results in a 2 % increase in housing prices in US cities. Following his formalized work, Saiz (2007) found that immigrants do not displace natives from "gateway" cities one for one. However, he argued that immigrants are less sensitive to housing costs, because local immigrant-specific amenities and networks are more important to them. The literature on the impact of immigration on the housing market has evolved, but there is no consensus among researchers regarding the short-run impact of immigration on rents and housing values. The empirical results are time- and country-specific.

Ottaviano and Peri (2006) analyzed in their seminal paper the US housing market and estimated that an increase in the diversity index by 0.1 (roughly the increase experienced by Los Angeles during the 1970–1990 period) is associated with a 19 % increase in real rents. In other countries, the estimates tend to be even smaller. The instrumental-variables approach of Gonzalez and Ortega (2013) suggests that between 2000 and 2010, immigration led to an average 1.5 % annual increase in the working-age population in Spain, which was responsible for an annual increase in housing prices by about 2 %, and for a 1.2–1.5 % increase in housing units.

Using individual panel data of homeowners in the Netherlands between 1999 and 2008, Bakens et al. (2013) found a positive effect of cultural diversity on average housing prices. But after controlling for spatial sorting, the effect of cultural diversity on housing prices is negative. Sá (2015) studied the effect of immigration on housing prices in the UK. The author found that immigration has a negative effect on housing prices and presented evidence that this negative effect is due to the mobility response of the native population. Natives respond to immigration by moving to different areas, and those who leave are at the top of the wage distribution. This generates a negative income effect on housing demand and pushes down house prices. The negative effect of immigration on housing prices is driven by the areas in which low-educated immigrants settle. Saiz and Wachter (2011) found a negative relationship between immigration and changes in housing prices and rents in the US at the local level. The authors provided three potential explanations for this outcome. First, natives may have a preference for living with residents of the

same ethnic group and of higher socio-economic status. In other words, some individuals may have a dislike for living in multicultural environments. This can arise if the indigenous population feels that cultural assets are threatened by the presence of foreign-born people. Second, immigration may generate more crime or affect the quality of locally provided public services (e.g. schools), which may be overcrowded. Finally, immigration may affect the quality of the housing stock. Furthermore, they suggested that the negative association between immigration and changes in housing values is stronger in the neighborhoods in which immigrants are less educated and tend to be ethnic minorities. This empirical fact is consistent with the idea that natives are willing to pay a premium to live in predominantly native areas.[28]

4.3 Theoretical framework and hypotheses

According to economic theory, an immigrant-induced increase in demand for housing is expected to have an upward effect on housing prices, particularly in large cities. Since immigration will be driving much of the German population growth in the near future, some argue that this phenomenon will cause a housing price appreciation. It is generally assumed that the housing market adjusts more slowly to immigration shocks than the labor market does because housing is considered to be a non-tradable good with relatively inelastic supply in the short term. This means that the impact of immigration on rental prices also depends on the elasticity of housing supply. At the same time, if immigrants and natives are substitutes in the labor market, natives may prefer to leave the area to avoid possible competition. In this case, the outflow of natives may neutralize the positive effect of an immigration shock on the housing market. As a result, prices decrease or remain unchanged.[29] Furthermore, growing immigrant enclaves, ghettos, or parallel societies may negatively influence rental prices if the natives have negative attitudes towards foreigners, motivated by a preference for homogeneity in terms of culture and social status, and/or by racial or religious prejudices. Moreover, natives might be concerned about a deterioration of local living standards if they make foreigners responsible for a rise in crime. Further concerns might arise because immigrants could have a crowding effect on local indivisible goods (i.e. parks, transport). More importantly, the probable short duration of stay in the same place may decrease the incentives of immigrants to invest in local public goods. Finally, even local politicians could be tempted to cut down investments, for example, in infrastructure in minorities-dense areas because foreigners do not have the

[28] For more details about the effects of immigration on the housing market, see also Van der Vlist et al. (2011) or Akbari and Aydede (2012).
[29] It should, however, be noted that Germans are relatively immobile compared to the population in the US.

right to participate in elections (for more details, see Accetturo et al., 2014).

All these aspects could trigger an offsetting native out-migration, and a decrease in wages, thereby reducing housing demand and prices in the city, or even segregation. It has been shown empirically that native residents differ in their preferences for living in a multicultural environment, depending on their appreciation of the implied diversity of cultural values (Bajari and Kahn, 2008; Baranzini et al., 2008; Olfert and Partridge, 2011). Additionally, though foreign migrants often settle in cities because of thriving economies (see Scott, 2010), they also contribute to the diversity of manmade consumption amenities in cities — including ethnic products, restaurants, and arts and entertainment events (Quigley, 1998; Glaeser et al., 2001). Arguably, a more unbalanced ethnic or racial composition of the population raises the attractiveness of living in cities, and this "ethnic capital effect" is thought to positively influence housing or rental prices (Ottaviano and Peri, 2006) — thereby opposing a potential "native escape". The issue is that, a priori, one cannot conclude which effect dominates. The uncertainty about the direction of the final effect leaves room for further analysis.

A simple model is introduced to illustrate the link among immigration, native mobility in response to immigrant inflows from abroad, and house prices. The model should help to understand the local impact of the cultural background on housing. The model is an extension of the frameworks proposed by Saiz (2007) and Accetturo et al. (2014) to define cultural identity as a district-specific amenity that enters into the utility function. If diversity is an amenity (disamenity), then residents would be willing to pay higher (lower) rents in culturally diversified districts. Start by assuming that the preferences of individuals i living in district d can be represented by the following utility function:

$$U_{id} = A(div_d)H_{id}^{1-\alpha}C_{id}^{\alpha} \tag{4.1}$$

in which $0 < \alpha < 1$, H is the consumption of housing, and C is the consumption level of a homogeneous good. The price of this good has been normalized to one. The term $A(div_d)$ refers to the amenities in district d and captures the "utility effect" associated with local diversity. If natives value cultural diversity, the first derivative ($\partial A/\partial div_d$) is positive. On the contrary, if migrants cause a perceived deterioration in the quality of local amenities, then $\partial A/\partial div_d < 0$.

Assuming that income does not depend on the location within districts, individuals maximize the utility subject to the following budget restriction:

$$C_i + r_d H_i = Y_i \tag{4.2}$$

in which r_d and Y_i represent, respectively, the rents in district d and individual income.[30]

The utility maximization problem delivers the following Marshallian demand functions for housing and the homogeneous good:

$$\begin{aligned} H_i^* &= \frac{\alpha Y_i}{r_d}\,, \\ C_i^* &= (1-\alpha)Y_i\,. \end{aligned} \tag{4.3}$$

Suppose there are two districts, 1 and 2, and two types of individuals, natives and immigrants. The total number of natives is N, a share ω of which is located in district 1. The natives are free to move across districts, and we assume that a mass M of immigrants is located in district 2. The immigrant income is equal to γY, with $\gamma \in [0,1]$. The supply of immigrants is treated as exogenous, and the immigrants are assumed to prefer to stay in district 2. Therefore, the aggregate housing demand for each area is:

$$\begin{aligned} H_1^D &= \omega N \frac{\alpha Y}{r_1} \\ H_2^D &= [(1-\omega)N + \gamma M]\frac{\alpha Y}{r_2} \end{aligned} \tag{4.4}$$

Housing supply in district d is assumed to be equal to:

$$H_d^s = \beta_d r_d^{\theta}\,, \tag{4.5}$$

in which β_d is the price elasticity of the housing supply in district d and $\theta \geq 0$. In equilibrium, housing demand equals supply. The equilibrium prices are determined by equations (4.4) and (4.5):

$$\begin{aligned} r_1^* &= \left(\omega N \frac{\alpha Y}{\beta_1}\right)^{\frac{1}{1+\theta}} \\ r_2^* &= \left\{[(1-\omega)N + \gamma M]\frac{\alpha Y}{\beta_2}\right\}^{\frac{1}{1+\theta}} \end{aligned} \tag{4.6}$$

In terms of other (natural) amenities, it can be assumed that the two districts are ex ante identical. They differ only in the degree of cultural diversity. The inflow of immigrants alters the natives' valuation of local amenities. More precisely, amenities are a function of cultural diversity, that is, $A(div_d)$. It should also be assumed that amenities in district 1, unaffected by immigration, are fixed and equal to A, that is $A(0) = A$.

[30] The introduced model neglects the existence of a production sector for two complementary reasons. First, Accetturo et al. (2014) argued that most of the previous studies have found no considerable impact of immigration on natives' income. Second, like their case, wages do not vary at the district level, which is the geographical unit of analysis in this paper.

The free mobility of natives implies that, in equilibrium, their utility levels are equalized across locations. This implies:

$$\frac{A}{\left(\frac{\omega N}{\beta_1}\right)^{\frac{\alpha}{1+\theta}}} = \frac{A(div_d)}{\left[\frac{(1-\omega)N+\gamma M}{\beta_2}\right]^{\frac{\alpha}{1+\theta}}} \tag{4.7}$$

In equilibrium, the share of natives in district 1 is, therefore:

$$\omega* = \frac{N+\gamma M}{N}\Phi(M)\,, \tag{4.8}$$

where $\Phi(M) = \frac{\beta_1 A(div_d)^{\frac{1+\theta}{\alpha}}}{\beta_1 A(div_d)^{\frac{1+\theta}{\alpha}} + \beta_2 A(div_d)^{\frac{1+\theta}{\alpha}}} \in (0,1)\,.$

Using equations (4.5), (4.6) and (4.8), we can derive the city-level rent:

$$\bar{r}* = \frac{[(N+\gamma M)\alpha Y]^{\frac{1+\theta}{\alpha}}}{\beta_1^{\frac{1}{1+\theta}}\phi(M)^{\frac{\theta}{1+\theta}} + \beta_2^{\frac{1}{1+\theta}}[1-\phi(M)]^{\frac{\theta}{1+\theta}}} \tag{4.9}$$

Before deriving the core results of how migrants affect local rents and native out-migration, let us first discuss some characteristics of this model.

First, the model assumes that all migrants are exogenously concentrated in the same district, and utility-maximizing location decisions are allowed to the native population. This assumption may seem implausible because empirical evidence shows that immigrants do not locate randomly across cities. However, it represents a good guidance for the empirical part of the study, in which I show a (causal) effect of cultural diversity on the housing prices.

We can now assess how cultural diversity influences housing prices. For this purpose, I present the most important hypotheses with the aim of producing some clear testable predictions for the empirical part of the paper:

Hypothesis 1: The impact of cultural diversity at the district level is negative (positive) if cultural diversity deteriorates (improves) the perception of the quality of local amenities.

The impact of cultural diversity at the district level is obtained by deriving the log of (4.6) with respect to M:

$$\begin{aligned}\frac{\partial\ log(r_1)^*}{\partial M} &= \frac{1}{2}\left[\frac{\gamma}{N+\gamma M} + \frac{\phi'(M)}{\phi(M)}\right] \\ \frac{\partial\ log(r_2)^*}{\partial M} &= \frac{1}{2}\left[\frac{\gamma}{N+\gamma M} - \frac{\phi'(M)}{1-\phi(M)}\right]\end{aligned} \tag{4.10}$$

It is important to note that cultural diversity only partially accounts for the differences in urban attractiveness. Not only do the sizes or shares of cultural groups matter, the between-group cultural proximity within the area does too.[31] Consider, for illustrative purposes, a case in which district A is composed of 50 % French and 50 % Germans, and, in district B, 50 % of the residents are Germans and 50 % are Turks. The two districts are not equally attractive to migrants, though they have statistically the same level of cultural diversity. The literature has used different methods to act as a proxy for cultural ties, such as a common language, religion, or ethnicity (Boisso and Ferrantino, 1997; Melitz, 2008). In this paper, I exploited an original data set that contains information about linguistic proximity between German and all official languages of foreign nationals living in Germany. This concept describes how similar a culture actually is among these groups. The crucial difference between these two indices is that cultural diversity is mainly a quantitative measure, while cultural proximity is more of a qualitative measure. The linguistic proximity index provides better-adjusted and smoother indicators of proximity than the standard dummy for the common language used in most of the literature. From a theoretical perspective, a substantially large cultural similarity between natives and immigrants may decrease the probability of misunderstandings and social conflict, thus making an area more attractive. To identify whether there is a different effect of linguistic similarity and cultural diversity on the housing market, the following hypothesis will be tested:

Hypothesis 2: The inflow of immigrants who do share a similar culture with natives should yield rising housing rents and prices.

The extent of the impact immigrants have on the local housing market depends also on the reaction of natives on the sorting of foreigners into residential neighborhoods. The theoretical framework allows us to determine whether the outflow of natives from cities with a large proportion of immigrants tends to be higher. This theory will be examined in the context of the next hypothesis:

Hypothesis 3: Migration generates pressures for the outflow of natives because natives, in general, prefer to live in a neighborhood with people who share a similar culture.

[31] Note that this extension is not directly related to the formal model above because this goes beyond the scope of this chapter.

This can easily be obtained by deriving equation (4.8) by M:

$$\frac{\partial\ \omega^*}{\partial M} = \frac{\gamma}{N}\phi(M) + \frac{N+\gamma M}{N}\phi'(M) \tag{4.11}$$

The first term on the right-hand side represents the change in the income effect — the crowding out of natives due to increased demand for housing on the part of immigrants — and is always positive. The second term captures the change in satisfaction with local amenities and is positive whenever immigration lowers the level of satisfaction with local amenities. The income effect is, thus, reinforced (or attenuated) by the amenities effect if the immigrants decrease (or increase) the value of the local amenities in area 2. This is one of the reasons why certain immigrant groups live in segregated neighborhoods, not because they prefer to live in those places but because natives restrict their location choices to specific areas.

4.4 Measuring cultural diversity and linguistic similarity

In the estimations, I have included two variables related to foreign citizens to measure cultural diversity. Firstly, I controlled for foreign residents as a share of the total population, i.e. $s_{dt} = foreigners_{dt}/population_{dt}$. This variable refers to the size of the group of foreign individuals who live in district d in time t. The second variable then specifically measures the degree of diversification of the stock of residents into different nationalities. The nationality is used as a proxy for cultural background. The number of nations or islands included in the analysis is 206. There is also information on stateless people whose citizenship is unknown/not clarified. However, these only make up a small proportion of the overall foreign population. To calculate cultural diversity, I used a standard Herfindahl-Hirschman index, an indicator frequently used in the socioeconomic research literature (see, for example, Ottaviano and Peri, 2005). The calculated diversity index is defined as:

$$div_{dt} = 1 - \sum_{i=1}^{n}(E_{dt}^i)^2, \tag{4.12}$$

in which E_{dt}^i is the share of people from the cultural group i among the residents of district d in year t. The index ranges between 0 and 1. An index value of 0 indicates that everyone living in a city belongs to the same cultural group, while the index rises the more evenly the shares of the different foreign nationalities are distributed. The advantage of this measure of heterogeneity is that it takes into account both cultural "richness" (i.e., the number of different groups in the population) and cultural "diversity" (i.e., the distribution across groups). The correlation between s_{dt} and div_{dt} in the data

seems to be rather modest ($\rho_{s,div} \approx 0.45$), which allows the inclusion of both variables in the analysis at the same time and, thus, to separate the fractionalization and size effects of the foreign residents. Moreover, in line with recent research, which distinguishes between the size of the migrant community and its diversity, I decomposed an additional index to measure the diversity of non-German-born residents (i.e. excluding the dominant, native residents from the index, see Suedekum et al., 2014). By doing so, I can test more precisely if it is diversity or simply the share of foreign-born individuals that influences the housing market.

To check that the empirical results do not depend too strongly on the particular form chosen for the diversity index, I considered, however, a more standard measure of diversity, namely, the "index of fractionalization". Formally, the fractionalization index of linguistic diversity of district d in year t is defined as:

$$frac(Lang_{dt}) = \sum_{i=1}^{n} (l_{dt}^{i})^2, \tag{4.13}$$

in which l_{dt}^{i} is the share of the group with the official language i in the host country in the total population of district d in year t. The index reaches its maximum value of 1 when all the residents speak the same language, and the minimum value of 0 when there are no individuals speaking the same language. Intuitively, when all the individuals share different languages, the probability that two randomly-selected individuals belong to same linguistic groups is 0, whereas it is 1 when all individuals speak the same language.

4.5 Data and descriptives

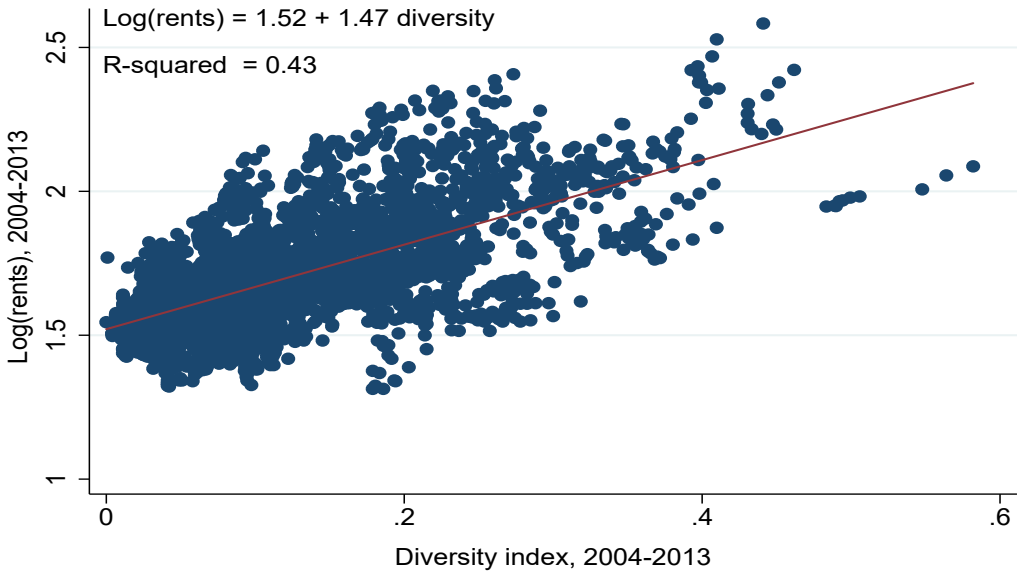
The data used in this chapter came from five different sources. The data on the inserted housing prices per square meter in Euro was provided by the Empirica regional data base, an independent institution for economic and social sciences. The average valuation price was used, because the data that would allow me to distinguish between the qualities or the characteristics of the properties did not exist. Furthermore, the city crime data came from the Federal Criminal Police Office. The Federal Institute for Research on Building, Urban Affairs and Spatial Development and the German Federal Statistical Office provided the data on the rental prices, the number of foreigners, and the control variables. CEPII's database provided the various measures of linguistic proximity. I used these unique data for the common native language and the common spoken language for many countries to act as the proxy for cultural similarity. For example, the common language index based on the level specification between Germany and Austria is 0.88. This means there is a high degree of cultural similarity between these two countries. The same index shows a value of zero between Germany and India, which can be interpreted in

terms of cultural dissimilarity. The geographical unit of analysis corresponds to a panel of 402 administrative districts and autonomous cities (NUTS 3) over 10 years (2004-2013). In my final data set, I had 3,927 observations. I worked with an unbalanced panel, as I did not have enough observations for all the 10 years and for all the 402 districts and autonomous cities. From an economic perspective, it would be interesting to identify how the housing market reacts to cultural diversity at the municipality level because housing prices can differ within cities. But, unfortunately, there is no data on housing or rental prices at this disaggregated level.

Germany is still a country of tenants. The ownership rate, according to the census of 2011, is about 45 % nationwide. In particular, the housing markets in major cities are heavily characterized by rental contracts. The ownership rate in Berlin, for example, is only 15.6 %, compared to 24.1 % in Hamburg. The reasons for the large proportion of tenants in Germany are conditioned due to historical, cultural, and economic factors. The Allies damaged a considerable part of the living space in German cities during World War II. About 20 % of the housing stock in West Germany was destroyed. Also, refugees who had lost everything entered from the East into the country. In 1950, there was a shortage of dwellings worth 4.5 million. But the government did not respond by incentivizing Germans to buy property; rather, it promoted social housing grants, guarantees, and the possibility of write-downs for the building owners. In addition, the housing market was liberalized soon after the war (German Federal Statistical Office, 2014). In recent years, the housing shortage has been growing massively, particularly in the agglomerated areas, primarily affecting the households with low and middle incomes. Like the US, private households in Germany spend, on an average, almost a third of their net salary on the rent and operating costs. Living in metropolitan areas is still considerably more expensive (Kholodilin, 2015). Due to further immigration, a rising demand for housing is expected, especially in the major cities. The effect of an increase in the stock of immigrants depends on the income of migrants, the price elasticity of housing supply, and the displacement of domestic residents to other areas (Meen, 2016).

Economic theory suggests the possibility of a causal impact of cultural diversity for the mean rents. Before using formal econometric methods to test this hypothesis, a preliminary graphical representation helped reinforce my findings of a positive correlation. Figure 4.1 shows the linkage between the cultural diversity index and the logarithm of rents. It should be noted that this approach does not enable us to eliminate the effect of fixed district characteristics, such as locational or geographical amenities. The OLS coefficient estimate implies that a one-standard-deviation increase in the amount of 0.08 in the diversity index (as, for example, Frankfurt did) is associated with an increase of 12 % in the average rent prices, relative to cities whose diversity index did not change at all. This is the case especially for many cities in eastern Germany.

Figure 4.1: Correlation between the logarithm of rents and diversity index



Source: Own illustration based on FIRBUS and the German Federal Statistical Office.

Descriptive statistics for the main variables used in the regression framework are summarized in Table 4.1.

Table 4.1: Summary statistics

Variable	Mean	Std. Dev.	P25	P50	P99
Cold rent per m^2	5.6	1.1	4.8	5.3	9.7
House price per m^2	1,327	398	1,071	1,273	2,696
Share of foreigners	0.07	0.05	0.03	0.06	0.23
Diversity index	0.13	0.08	0.07	0.11	0.40
GDP per capita	28,383	11,607	21,068	25,352	75,722
No. of observations	3,927				

Source: Own illustration based on FIRBUS and the German Federal Statistical Office.

The average basic rent at the district level is 5.6 Euros per square meter, and the variation across the districts is considerable. Moreover, in the average district, there are about 7 % foreigners. In terms of cultural richness and diversity, the regions also differ greatly from one another. Diversified cities like Munich, or the small district of Saarlouis, have diversity indices between 0.4 and 0.6. The more homogeneous cities like Bayreuth and Leipzig exhibit a degree of fractionalization smaller than 0.05.

Figure 4.2 and Figure 4.3 reveal the uneven distribution of cultural diversity and cold

rents per square meter across German districts.[32]

Figure 4.2: Diversity index, 2013

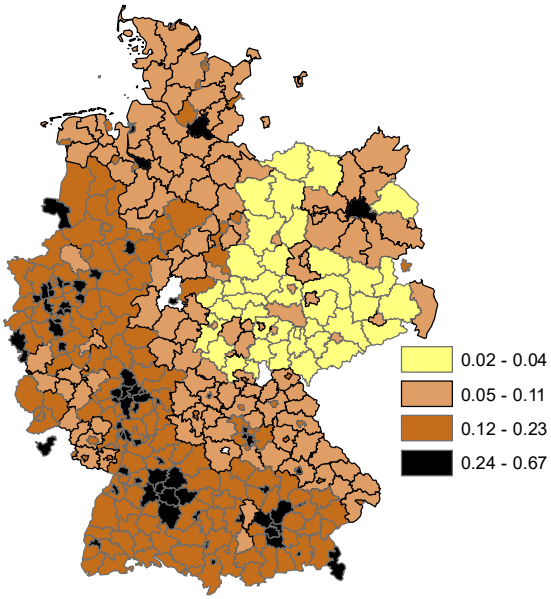
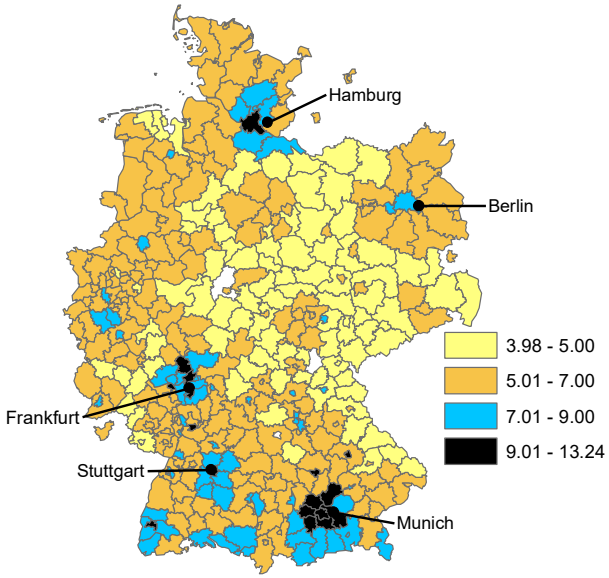


Figure 4.3: Rents per square meter, 2013



Source: Own illustration based on FIRBUS and the German Federal Statistical Office.

The proportion of non-natives in West Germany is higher compared to East Germany. One in five citizens in Germany has a migration background. For example, in North Rhine-Westphalia, the share of immigrants is about 25 %. As expected, cultural diversity clearly rises with the total regional size: the more densely populated agglomerated regions like Berlin or Hamburg tend to host people with various foreign nationalities. The housing market also shows a striking pattern because it is becoming spatially and structurally more differentiated. The spreads between "cheap" and "expensive" districts are wide. The rental price range is particularly pronounced between prosperous and shrinking regions. Housing is most expensive in Munich compared with any other district in Germany. Residents in the Bavarian capital pay 65 % more than the national average. Half of the 30 most expensive cities are located in Baden-Württemberg. Actually, in Eastern Germany or in the rural areas, both rents and the degree of diversity are below the national average. It is clear that cultural diversity is particularly high in the economically well-developed regions like Frankfurt or Munich. This would confirm the theory that regions with a high economic activity attract more migrants. In fact, at first glance, the rents in the culturally diversified areas are higher compared to the more homogeneous regions. However, if the other characteristics are not controlled for, these correlations are, at best, only suggestive, as they may be affected by omitted variables or reverse causation. In the following section, I will deal with these issues.

[32] Figure 4.4 and Figure 4.5 in the Appendix show the spatial distribution for further important indicators, namely, for the share of foreigners and GDP per capita.

4.6 Empirical methodology

The theoretical model predicts that an increase in the diversity index would raise the average housing and rental prices at the city level. This prediction can be readily tested by using the following linear specification:

$$\log(r_{dt}) = \beta div_{dt} + X'_{dt}\psi + \varphi_d + \lambda_t + \varepsilon_{dt} \tag{4.14}$$

in which the dependent variable, $log(r_{dt})$, is either the natural logarithm of housing or rental price per square meter, respectively, in district d in year t. The independent variable of interest, div_{dt}, is the diversity index calculated among the entire population of the district. Area fixed effects (φ_d) are considered to control for time-invariant heterogeneity among districts, and year dummies (λ_t) capture the common housing market business-cycle shocks. The variable X'_{dt} is a vector of district time-varying controls. Finally, the term ε_{dt} is a random error with zero mean, and is independent of the other regressors. I applied a set of control variables which may affect the housing market. It includes the following variables: 1) the share of foreigners, 2) the gross domestic product (GDP), and the unemployment rate to control for the local macroeconomic conditions [33], 3) the population density to pick up agglomeration effects [34], 4) the local home burglary rate, which may affect housing demand [35], 5) the ratio of the number of dwellings to the local population to take account of the housing supply, and 6) a set of local (natural) amenities. In addition, the variable "overnight stays of guests per 1,000 inhabitants in hotels" is also included in the regression equation as a proxy for the attractiveness of the city. This indicator provides information about the quantitative importance of tourism in a region. It is also called "tourism intensity". Consequently, increased demand for attractive residential space results in higher prices in the housing market (Brueckner et al., 1999). This variable can also be considered as a local amenity related to housing prices. Amenities are generally defined as place-specific assets that are known to contribute to a city's attractiveness. The depth and breadth of amenities attract households to the hosting region. One strand of research shows that location decisions are also driven by amenity considerations (Clark et al., 2002; Glaeser et al., 2005).

To test hypothesis 2, I used the total native outflows (NO) as the dependent variable because immigrant inflows can lead to outflows of natives. To empirically identify this

[33] Because richer provinces that are growing faster and employing more people could be attracting more immigrants and, thus, could also be registering a higher growth in house and rental prices.
[34] Population density is computed by dividing the total population by the size of the district in square kilometers.
[35] High levels of recorded home burglaries will affect the demand for housing in the affected areas, and that will inevitably lead to lower rental prices. For example, Thaler (1978) found that property crime reduces house values by about 3 %.

phenomenon, the following equation can be used:

$$log(NO_{dt}) = \beta log(imm_{dt}) + Z'_{dt}\psi + \varphi_d + \lambda_t + \varepsilon_{dt}\,, \tag{4.15}$$

where imm_{dt} is the immigration of foreigners, and Z'_{dt} stands for a vector of controls. The unemployment rate and GDP per worker are the covariates traditionally used in the literature as the main determinants of the migration flows. They measure the job opportunities in an area and clearly determine the expected income. Furthermore, rents and home burglary rate are also included as explanatory variables in the regression equation.

Obviously, it may be so that cultural diversity and the share of foreigners are endogenous to rents. The presence of immigrants may increase rental prices because cultural diversity is considered as a positive amenity. Conversely, immigrants settle in areas with higher rental prices because they signal more favorable location characteristics (Bakens et al., 2013). If immigration inflows are very sensitive to housing costs, the estimates of the relation between cultural diversity and housing markets could be biased downward. Despite controlling for the potential influencing indicators, the estimation of the coefficients β and δ in the regression models (4.14) and (4.15) by ordinary least squares (OLS) may still suffer an endogeneity bias. Another point is that the sign of the bias is difficult to predict ex ante. In this context, one needs to look for exogenous sources of variation in the immigration inflows to ascertain causality (Saiz, 2007). Moreover, the omitted variables that cannot be controlled for could be driving both immigration inflows and housing costs. Immigrants may respond to other factors that cause rents to increase, such as expectations of future economic growth, improved amenities, or changes in the preferences for existing amenities. In principle, this could lead to overestimating the impact of cultural diversity on rents.

To assess the causal relationship between the two variables diversity and share of foreigners with rents, I, therefore, instrument the two endogenous regressors in two ways. One possible solution to tackle these problems would be to seek external instrumental variables that are correlated with the change in the diversity of cities in the considered period, but are uncorrelated with any city-specific shocks. This strategy has been frequently used in the studies that focus on the impact of diversity on the local economies (Card, 2005; Ottaviano and Peri, 2006). First, following Bakens et al. (2013), I again used the shift-share methodology to predict current diversity based on immigrants' location choices in the past. For each city, I used the share of immigrants from a specific culture (i.e., foreign nationality) in 1998 to predict the share between 2004 and 2013 by allocating the national growth rate of that culture to the initial city level as follows:

$$\widehat{E^i_{dt}} = E^i_{dt=1998}[1 + g_{i,1998-t}] \tag{4.16}$$

where $\widehat{E^i_{dt}}$ is the estimated share of migrants with culture i in district d in year $t = 2004, ..., 2013$, $E^i_{dt=1998}$ is the share of migrants with culture i in district d in 1998, and $g_{i,1998-t}$ is the overall national growth rate of the share of culture i from 1998 to year $t = 2004, ..., 2013$.

As the second instrument, I used the gateways instrument to take into account potentially endogenous location choices of foreigners (for more details, see Gonzalez and Ortega, 2013). The idea behind this approach was to exploit the differences in physical accessibility across German districts. Immigrants enter Germany either by land, sea, or air, and the most common mode of transportation varies widely by the country of origin. The main dimension of immigrants' access is the distance between the area of origin and destination. We would expect higher migration flows from countries closer to Germany. For instance, in 2013, the share of Danes accounted for about 30 % of the total foreign population in the border town of Flensburg, making them by far the largest immigrant group in this town. There were 20,312 Danish immigrants living in Germany, and 11 % of them had settled in Flensburg. More specifically, the construction of the gateways instrument to predict the foreign-born population in district d and year t is as follows:

$$GI^i_{dt} = \sum_{i=1}^{n} \gamma_{di} FB^i_{dt} \ , \qquad for \quad t_0 < t. \tag{4.17}$$

Within-district changes of immigrants over time in GI^i_{dt} are the basis for the gateways instrument. FB^i_{dt} is the share of foreign individuals with nationality i who inhabited district d in the base year t. Furthermore, γ_{di} is a weight varying by the country of immigration and district. This parameter measures the degree of accessibility of each German district from each country of origin. The basic idea is to calculate the distance between two countries based on bilateral airline distances in kilometers between the capitals of those two countries (Mocetti and Porello, 2010). I used data from CEPII, which provides current population figures and geographical coordinates for cities, towns, and places of all countries. Moreover, I considered three additional instruments. These are, respectively, the first time-lagged values of the endogenous regressors. The above-mentioned instruments are likely to be correlated with the size of the foreign residents in an area, but unlikely to be correlated with the housing market characteristics. The requirement that the instruments need to vary across cities and time is fulfilled here. According to a standard Hansen J-statistic, these are suitable instruments for the current levels of cultural diversity, immigration, and share of foreigners. The use of various instruments should correct for the bias that would plague OLS estimations.

4.7 Empirical results

Table 4.2 and Table 4.3 (see in the Appendix) report the estimation results based on the model described in (4.14).[36] The second stage of the estimation procedure is presented in the last column.

Table 4.2: The impact of cultural diversity on rents

Regressor	**OLS**	**FE**	**IV**
Diversity index	1.27***	1.18***	1.23***
	(0.08)	(0.06)	(0.12)
Share of foreigners	-0.01	-0.01	-0.03
	(0.01)	(0.03)	(0.02)
Unemployment rate	-0.02***	-0.002***	-0.02***
	(0.002)	(0.0004)	(0.002)
Log (GDP per capita)	0.20***	0.02**	0.20***
	(0.02)	(0.01)	(0.02)
Log(population/size)	0.16***	0.80***	0.16***
	(0.01)	(0.04)	(0.01)
Log(stock of dwellings/population)	-0.63***	-0.32***	-0.67***
	(0.084)	(0.026)	(0.19)
Area fixed effects		✓	✓
Time fixed effects		✓	✓
R^2	0.60	0.52	0.60
F-test			69.68
Hansen J statistic (p-value)			0.157 (0.69)
N	3,927	3,927	3,927

Note: Heteroskedasticity robust standard errors in parentheses.

Instruments: shift share and gateway.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on the Federal Statistical Office, FIRBUS and the Federal Criminal Police Office.

The estimates of the coefficient β suggest that an increase in the diversity index by 0.1 is associated with a 12–13 % increase in rents and a 10–15 % increase in house prices.[37]

[36] The next estimation tables will primary focus on the effect of the variables of interest on rents because the main findings do not change significantly when housing prices are considered.

[37] I also estimated equation (4.14) using the index for diversity among migrants only. This modification

All estimation methods show that cultural diversity is positively associated with rents and house prices. On the other hand, I find negative rental price effects from the total share of the foreign population. An increase in the share of foreign-born people by 1 % would cause a 1 % decrease in rents. But this correlation is not statistically significant. However, the IV estimate reveals a stronger negative and still insignificant effect of the share of foreigners on the average rents at the district level. That is, rental and house prices are lower in the German regions with a large share of foreign inhabitants, but for a given share, the rental and house prices are higher if the residents are diversified into many nationalities.

In fact, the macroeconomic variables and the population may depend on several exogenous factors and affect the rental prices. In reality, there is no doubt that wages are the prime determinant of income, while migration is a major driver of population growth. The two potential channels through which diversity can affect rents are either by increasing productivity (which would be reflected in higher wages and rents), or by increasing the desirability of a city. After controlling for income [38] and population (density), a residual significant positive effect of diversity would imply that city dwellers do value cultural diversity per se, and are willing to push up rents more than what would be implied only by a higher income and a higher population. The positive estimated sign of the diversity parameter indicates that diversity has a positive amenity value and plays a role in determining rents. It can, therefore, be stated that the areas hit by different nationalities are likely to experience an improvement of local amenities. The positive amenity effect of diversity (for example, in terms of immigrant-induced product variety) does outweigh the negative effect of cultural diversity on rental prices.

The effect of cultural diversity on the German housing market is weaker than, for example, the one in the US or in the Netherlands (see Ottaviano and Peri, 2006; Bakens et al., 2013). There are some reasons why my estimates are smaller than the ones computed by Ottaviano and Peri (2006). For example, the difference could be explained by the fact that the US experienced higher levels of net migration during the observation period (World Bank). Additionally, the US has a different place-of-birth composition and different characteristics of immigrants. More importantly, the attitudes of German citizens toward immigrants may differ from those of Americans because of their different history, culture, and values. Another point is that urban features of metropolitan areas are very different between the two countries, e.g. in terms of the spatial distribution of population or the infrastructure (Wiechmann and Pallagst, 2012).

does not significantly change the main findings.

[38] GDP per capita is used as a proxy measure for income.

The test for weak instruments is based on the Cragg-Donald F-statistic for the joint significance of instruments. The number 69.68 for the model with the rental prices as the dependent variable is larger than the rule of thumb of 10 (Stock and Yogo, 2005). Therefore, the instruments appear to be strong. According to Hansen's J-test, the used instruments are suitable for the current levels of cultural diversity and share of foreigners. The comparison between OLS and IV shows that the estimators are nearly equal. But all specifications demonstrate that cultural diversity has a stronger effect on house prices than on rents. The estimated effect of the share of foreigners was stronger and significant if I considered only West Germany. I restricted the sample to West Germany (including East and West Berlin) because the share of the immigrant population residing in East Germany outside Berlin was very small. Table 4.4 shows that according to the spatial equilibrium model proposed by Roback (1982), the total share of foreigners is a negative city amenity. Natives possibly perceive the strong presence of one particular foreign group as an unattractive location characteristic, because they fear that foreign infiltration gives rise to parallel societies — or the emergence of ghettos in German cities (Mueller, 2006). As it is shown in Table 4.5, culturally diverse urban areas experience faster rent appreciation compared with all the districts in the sample. An increase in the diversity index of 0.1 increases rental prices per square meter by about 15 %.

Table 4.4: *IV* results for West Germany
Dependent variable: Rents

Independent variable	**Coefficient** (Std. Err.)
Diversity index	1.21*** (0.06)
Share of foreigners	-0.10*** (0.03)
R^2	0.59
F-test	91.62
Hansen J statistic (p-value)	3.42 (0.18)
N	3,082

Table 4.5: *IV* results for urban areas
Dependent variable: Rents

Independent variable	**Coefficient** (Std. Err.)
Diversity index	1.49*** (0.36)
Share of foreigners	-0.50 (0.75)
R^2	0.43
F-test	31.49
Hansen J statistic (p-value)	2.50 (0.29)
N	1,779

This may reflect a large migration to high-density urban areas. The signs of control variables are in accordance with economic theory. As it could be expected, rental prices are higher in densely populated and prosperous areas. However, burglaries have a nega-

tive impact on the housing market regarding the estimated crime coefficient.[39] We can conclude from this result that natives are willing to pay a premium to live in a low-crime neighborhoods.

The models in Table 4.6 suggest positive and statistically significant estimators for cultural proximity.

Table 4.6: The impact of cultural similarity on rents

Regressor	**OLS**	**FE**	**IV**
Linguistic proximity index	1.60***	1.27***	1.61***
	(0.14)	(0.06)	(0.15)
Share of foreigners	-0.01	-0.01**	-0.01***
	(0.017)	(0.005)	(0.003)
Unemployment rate	-0.02***	-0.003***	-0.03***
	(0.002)	(0.0004)	(0.002)
Log (GDP per capita)	0.05**	0.02**	0.05**
	(0.02)	(0.01)	(0.02)
Log(population/size)	0.04***	0.67***	0.03***
	(0.01)	(0.04)	(0.01)
Log(total stock of dwellings/population)	-0.63***	-0.31***	-0.67***
	(0.084)	(0.003)	(0.188)
Area fixed effects		✓	✓
Time fixed effects		✓	✓
R^2	0.70	0.57	0.70
F-test			77.06
Hansen J statistic (p-value)			0.83 (0.36)
N	3,927	3,927	3,927

Note: Heteroskedasticity robust standard errors in parentheses.

Instruments: shift share and 1^{st} time lag linguistic proximity index.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on the Federal Statistical Office, FIRBUS and the Federal Criminal Police Office.

It is worth emphasizing that the magnitude of these estimators is somewhat larger than the coefficients for the variable cultural diversity. The estimates across the methods range

[39] The full estimation results for all the variables are available on request.

from 1.27 (column 2, fixed-effects model) to 1.61 (column 3, two-stage least squares). This indicates that local residents appreciate culturally diverse regions, but have more pronounced preferences if there is a similarity in terms of language between cultures. By studying a sample of 1,935 first-generation immigrants, Wang et al. (2016) showed that migrants prefer to move to regions with a cultural background similar to theirs, and this holds especially for EU migrants. The authors identified that migrants are more likely to choose regions that are geographically close to their country of origin. They also found a significant and robust negative correlation between the average cultural distance and the attractiveness of regions, while cultural diversity had a positive impact on it.

Table 4.7: *IV* results for the correlation between native out-migration and foreign immigration

Independent variable	**Coefficient** (Std. Err.)
Ln(immigration of foreigners)	0.20*** (0.04)
Unemployment rate	0.02*** (0.003)
Log(GDP per capita)	-0.07 (0.05)
Log(rents)	0.63*** (0.07)
Home burglary rate	0.06*** (0.01)
R^2	0.89
F-test	340.75
Hansen J statistic (p-value)	1.76 (0.18)
N	3,380

Table 4.8: *IV* results for the correlation between native out-migration and cultural diversity

Independent variable	**Coefficient** (Std. Err.)
Diversity index	-0.58*** (0.12)
Unemployment rate	0.02*** (0.002)
Log(GDP per capita)	-0.05** (0.02)
Log(rents)	0.13** (0.05)
Home burglary rate	0.02*** (0.007)
R^2	0.96
F-test	125.93
Hansen J statistic (p-value)	2.03 (0.15)
N	3,380

Finally, I tested hypothesis 3 by estimating Equation (4.15). To the best of my knowledge, this analysis is the first attempt to identify the reaction to immigration in Germany in terms of the internal mobility of natives. The rental price dynamics can be explained by the fact that natives decide to move to other districts and are willing to pay higher rents to avoid foreigners. I can provide direct evidence of this theory.[40] The estimates

[40] It should be noted that other reasons, like a job prospect, can also play a role in the location choices of natives. The use of data for the empirical analysis does not allow us to conclude that natives have

obtained from the second stage are displayed in Table 4.7.

The instruments (based on the distance from the gateways and the first-order time lag of the endogenous variable "immigration of foreigners") seem to be suitable. The first-stage F-statistic is well above the rule-of-thumb of 10, suggesting that the weak instrument problem is not an issue in my case. The correlation between the inflow of foreigners and the outflow of natives is statistically significant. The IV estimate shows a negative effect. Indeed, according to this estimate, a 1 % increase in the share of foreigners induces 0.2 % of the native population to relocate to other districts. This is (partly) consistent with the evidence identified by Mocetti and Porello (2010) for Italy, finding a crowding out of low-educated natives.[41] Conversely, Table 4.8 shows that native residents have no incentive to leave culturally diverse districts. The signs for the coefficient of the control variables are also consistent with intuitive expectations, further supporting the validity of the results. For instance, the estimated parameter for GDP per worker has the "correct" negative sign, which means that a high economic growth (i.e., more employment opportunities in the region) is negatively associated with net outflows of natives.

4.8 Robustness checks

In the hedonic literature, there has been a marked increase in the number of studies that highlight concerns about the spatial interdependence of residential prices. Dependence arises because housing typically consists of a set of interlinked local markets. The use of regional data sets that do not correspond to local housing markets will often introduce spatially correlated errors. Se Can and Megbolugbe (1997) gave rise to the possibility of spatial lags, where prices depend on prices in neighboring areas, rather than the correlation arising through the error terms. I have, so far, treated the districts as if they were independent of each other. However, it is likely that cross-regional spillovers exist and, thus, so does spatial dependence across the single units. Spatial interactions are also likely due to the common factors in the unobserved variables and/or the movement of households. To account for this issue, I used spatial econometric techniques. More specifically, I assumed a spatial AR(1)-process for the error term:[42]

$$\varepsilon_{d,t} = \rho \cdot \sum_{i=1}^{n} \omega_{i,r} \cdot \varepsilon_{i,t} + \upsilon_{d,t} \tag{4.18}$$

migrated to a more homogeneous environment only in response to foreigners. Nevertheless, we can obtain a first impression.

[41] Unfortunately, because of data restrictions, it is impossible to distinguish between different skill levels of natives in this study.

[42] For more details, see Suedekum et al. (2014).

where $\sum_{i=1}^{n} \omega_{i,r} \cdot \varepsilon_{i,t}$ is the spatial lag of the error process, ρ spatial autoregressive parameter and $v_{d,t}$ denotes an i.i.d. error term with zero expectation and variance σ_v^2. The error term for the period t can be written as:

$$\varepsilon_t = \rho \cdot W \cdot \varepsilon_t + v_t \tag{4.19}$$

The matrix W is the spatial row-normalized weighting matrix of dimension N x N[43] and collects the weights $\omega_{i,r}$. In my case, I used a simple contiguity matrix to allow for the contiguous neighbors that affect each other. I specified a panel model with fixed effects to estimate the parameter ρ. As it can be seen in Table 4.9, I still obtain positive rent effects for the diversity index. For the total share of foreigners, I obtained negative rent effects, in line with my previous findings. For the latter group, the coefficient estimator is similar to the fixed-effects model significant at the 5 % level. The outcomes do not change if we apply a modified approach developed by Kelejian and Prucha (2010). The authors used instrumental variables and the generalized-method-of-moments (GMM) to estimate the parameter ρ. These results confirm that my findings are robust to explicitly account for spatially correlated errors.

Table 4.9: *R*esults of spatial AR-model
Dependent variable: Rents

Independent variable	**Coefficient** (Std. Err.)
Diversity index	1.50*** (0.081)
Share of foreigners	-0.01** (0.005)
R^2	0.54
N	3,927

Lastly, instead of per-capita GDP, I also controlled for an average per capita income. Of course, this indicator was heavily related to the GDP, but it may also have affected the level of rents in a city. The inclusion of this regressor, however, did not seem to have much of an effect on the results of the base specification. In summary, the significance of diversity is remarkably robust to the variations in the basic regression. On the whole, the base specification point estimates seem to provide an accurate estimate of the true parameter value: a 0.1 increase in the diversity index is associated with a 15 % increase

[43] A matrix of the dimension of 391 x 391 was used for this analysis.

in rents.

4.9 Conclusion and Discussion

The aim of this chapter is to examine the impact of immigration on the housing market across German districts. I found that the cultural composition of the population matters in people's housing decisions. I developed three hypotheses: On the one hand, we have the natives' preferences for cultural diversity and/or language similarity as a proxy for close cultural ties between Germany and the immigrants' country of origin. On the other hand, we have the native residents' distaste for a huge number of foreigners. It is important to investigate these aspects to gain a better understanding of the impact of immigration on local markets and to gauge the consequences for the socio-demographic structure of the local population.

I first provide a theoretical guide to the empirical data, showing that the effects of migration on the rental prices at the district level are solely driven by the changes in amenities perceived by natives. These variances in the quality of life also influence the spatial distribution of natives within the districts. The empirical evidence demonstrates that a 0.1 increase in the diversification of the residents with respect to their nationalities at the district level raises housing prices by 11 to 15 %. This finding suggests that cultural diversity generates a clear improvement of local amenities as perceived by natives. Natives like to live in cities with different foreign nationalities because they value cultural diversity. One more striking finding of my study was that natives prefer to dwell in regions with a cultural background similar to theirs, which provides a strong support to the home-culture-preference hypothesis. People, in general, favor locations with greater cultural similarity, and are willing to pay more for housing in those communities. Moreover, the size of the group of foreign residents in a district has a negative but insignificant impact on housing prices. But the arrival of new migrants generates an outflow of natives to other districts. Native outflows are even greater in the districts characterized by adverse macroeconomic conditions. These results are robust in a series of extended analyses in which I tried to address different cultural diversity measures and endogeneity problems.

In recent years, many people have migrated to Germany, and the top source countries of newcomers have changed. The consequence is that the pattern of cultural diversity has shifted and is likely to alter further. It is unclear what effect the new composition of foreigners will have on the housing market. In fact, the housing market in Germany is undergoing a structural shift and is faced with major challenges due to the housing shortage. There are two main causes for this problem: 1) The aging of the German population, and 2) the increasing concentration of jobs in urban areas. On the one hand, the elderly are dependent on well-functioning infrastructure (doctor, supermarket,

transport), which should be easily accessible on foot. On the other hand, many workers wish for, partly due to financial reasons (e.g. doing without a second car), a certain proximity to their workplace. In addition, the propensity of immigrants to settle in the large urban areas (people go where the jobs are) could once again aggravate this situation. In general, the quality of life and job or training opportunities in cities are higher than those in rural areas. This phenomenon attracts more and more people to the cities, which, in turn, can trigger rising rental prices in the city and declining ones in the countryside. The strained housing situation in cities is also exacerbated by the fact that the subjective space requirement increases continuously. For example, a small apartment with a capacity for a four-person household in the 1930s is now mostly inhabited by a single person. The housing shortage in the metropolitan areas is, therefore, mainly caused by the (rational) behavior of the native population itself. This existential problem can be eliminated by new buildings.

What remains to be identified for future research is the set of channels through which the arrival of immigrants causes changes in the perceived amenities. When more data are available, one could also investigate the impact of immigration on mobility, depending on the skill composition of natives. For example, well-educated natives might have a more positive attitude towards immigrants, because the human capital theory claims that a higher level of education leads to a higher level of tolerance (Borgonovi, 2012). That means having a considerable number of immigrants in a neighborhood would not lead to out-migration of the highly educated natives.

4.10 Appendix

Figure 4.4: Share of foreigners, 2013

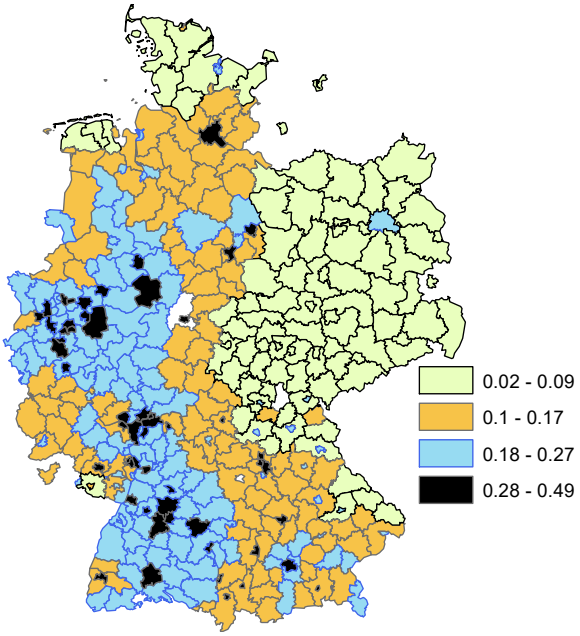
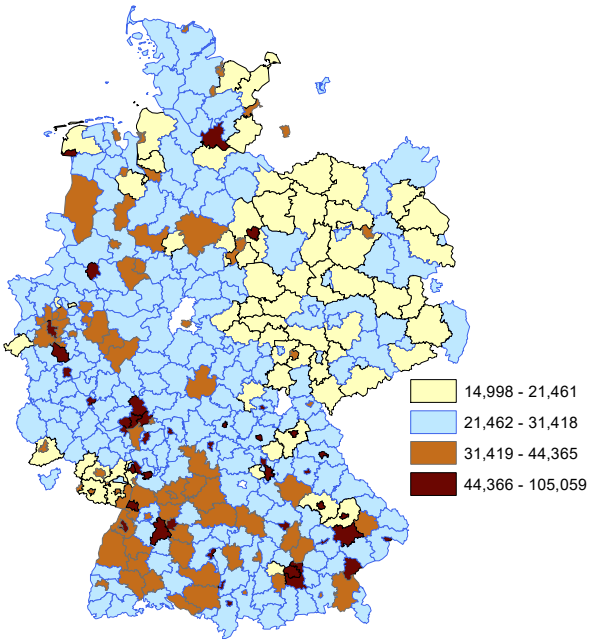


Figure 4.5: GDP per capita, 2012



Source: Own illustriation based on the German Federal Statistical Office.

Table 4.3: The impact of cultural diversity on housing prices

Regressor	**OLS**	**FE**	**IV**
Diversity index	1.53***	1.54***	1.09***
	(0.088)	(0.06)	(0.12)
Share of foreigners	-0.01	-0.03	-0.07***
	(0.017)	(0.036)	(0.019)
Unemployment rate	-0.03***	-0.01***	-0.08***
	(0.002)	(0.0004)	(0.002)
Log (GDP per capita)	0.02	0.06***	0.03
	(0.02)	(0.01)	(0.02)
(Log(Population/size)	0.08***	0.08**	0.20***
	(0.01)	(0.04)	(0.01)
Log(Total stock of dwellings/population)	-0.57***	-0.97***	-0.63***
	(0.084)	(0.026)	(0.19)
Area fixed effects		✓	✓
Time fixed effects		✓	✓
R^2	0.45	0.35	0.61
F-test			49.09
Hansen J statistic (p-value)			0.932 (0.63)
N	3,927	3,927	3,927

Note: Heteroskedasticity robust standard errors in parentheses.

Instruments: shift share and gateway.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Source: Own illustration based on the Federal Statistical Office, FIRBUS and the Federal Criminal Police Office.

5 Conclusion

This dissertation provides useful contributions for both academics and policymakers. The purpose of the presented thesis was to provide new empirical evidence about the impact of immigration on the German labor and housing markets by extending the existing approaches. In chapters 2 and 3, I identified widely accepted results within the immigration literature and showed the fragility of some of the underlying methodological underpinnings of past research. In **chapter 2**, I allowed the impact of immigration to differ between and across different skill groups (low, medium, and high) of the natives, and identified the impact of immigration using the variation of the share of foreigners in districts over time. This procedure is often referred to as the spatial approach. Spatial units are intended to correspond to geographical labor markets. In my context, the spatial units used for empirical analysis were 325 German districts. To address the issue of endogeneity of the location choice of immigrants, I used the shift-share strategy to instrument the endogenous regressor share of foreigners. The instrument relies on the past sorting pattern of immigrants. The idea is that immigrants tend to settle in areas where communities of the same nationality group already exist. The aim of exploiting past immigrant concentrations was to remove the effect of unobserved demand shocks that might affect immigrants' location choices. In all the regressions, I found a significant relationship between immigration and labor market outcomes (wages and employment) of native workers. Moreover, my results indicate that highly skilled natives may benefit most from immigration, suggesting that immigrants are complements for these types of workers in the German labor market. These key findings are consistent with earlier studies for Germany which found small or no effects of immigration on labor market outcomes of German natives.

I challenge the consensus in the existing literature and propose a new framework to help analyze more accurately the wage effects of immigration. There are two reasons for this extension: First, immigrants are often misplaced in the labor market with respect to educational attainment (Piracha et al., 2013). Second, according to empirical evidence, immigrants and natives specialize in different occupations (Ethan and Peri, 2015). Hence, I suggest that the labor market be split into occupation groups instead of education. I used the same data and covariates to apply the so-called occupational approach (national-level analysis). To my knowledge, I am the first to use occupation-specific skills to define homogeneous labor groups (with respect to observable characteristics) in the context of Germany and the implemented identification strategy. I used the occupational distribution of immigrants and natives, in which I distinguished among 12 occupational categories. The main advantage of this approach is that it takes into account the occupational mobility of workers in terms of occupational change or upgrade of individuals, i.e. by moving from low-wage occupations to more highly paid ones. My estimates of the direct within-occupational effect of the proportion of foreigners are not extremely large.

But they are just partly in line with the results estimated by the spatial approach. The major difference between the two is that in some occupational groups, natives suffered a negative wage effect by immigration inflows from the non-EU countries. Migrants and native workers seem to be close substitutes for each other in these occupational groups.

In **chapter 3**, I assessed the impact of immigration on local labor markets in Germany from a task-based perspective. I empirically tested the predictions of Peri and Sparber (2009) general equilibrium model, in which (low-skilled) immigrants who lack proficiency in the host country's language have a comparative advantage over natives in simple (routine manual and non-routine manual) rather than complex (analytical, communicative, and cognitive) tasks. This comparative advantage has the following implications: (i) immigrants tend to specialize in jobs that need more manual than complex skills, and (ii) natives respond to lower wages that result from increased labor supply in such jobs by shifting to occupations with a lower manual-to-complex task ratio. Using German data from 1990 through 2014, I found that an increase in the foreign-born share has a significant positive effect on the natives' relative complex task supply. IV estimation suggests that natives increased their relative task provision by 0.624 % for every percentage point increase in the less-educated foreign-born share. I also identified that this effect is driven by immigrants from the EU countries, while the effect of immigrants from the non-EU countries is insignificant. Moreover, my results indicate that an increase in the share of foreign-born workers has a greater impact on native women and young workers.

In **chapter 4**, I analyzed the impact of cultural diversity and the total share of foreigners on the German housing market. Endogeneity issues related to immigrants' spatial distribution were addressed by using two instrumental variables: geographical proximity between immigrants' source countries and German districts, and the shift-share instrument. I found that the diversification of the foreign residents with respect to their nationalities has a positive effect on the average rental and housing prices. This effect will be reinforced if there is a language similarity between the foreigners and the native inhabitants. However, the size of the group of foreigners in the districts had a negative effect on the housing market. These results are robust in a series of extended analyses in which I tried to address alternative explanations for the positive significant effect of cultural diversity. The results have potentially important implications for migration policies and research, because the debates mostly focus on the number of migrants and their education level, while compositional effects like the cultural diversity or similarity within that group are often neglected. My results suggest that the cultural composition of a society is crucial when it comes to assessing immigrants' effects on the local housing markets.

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